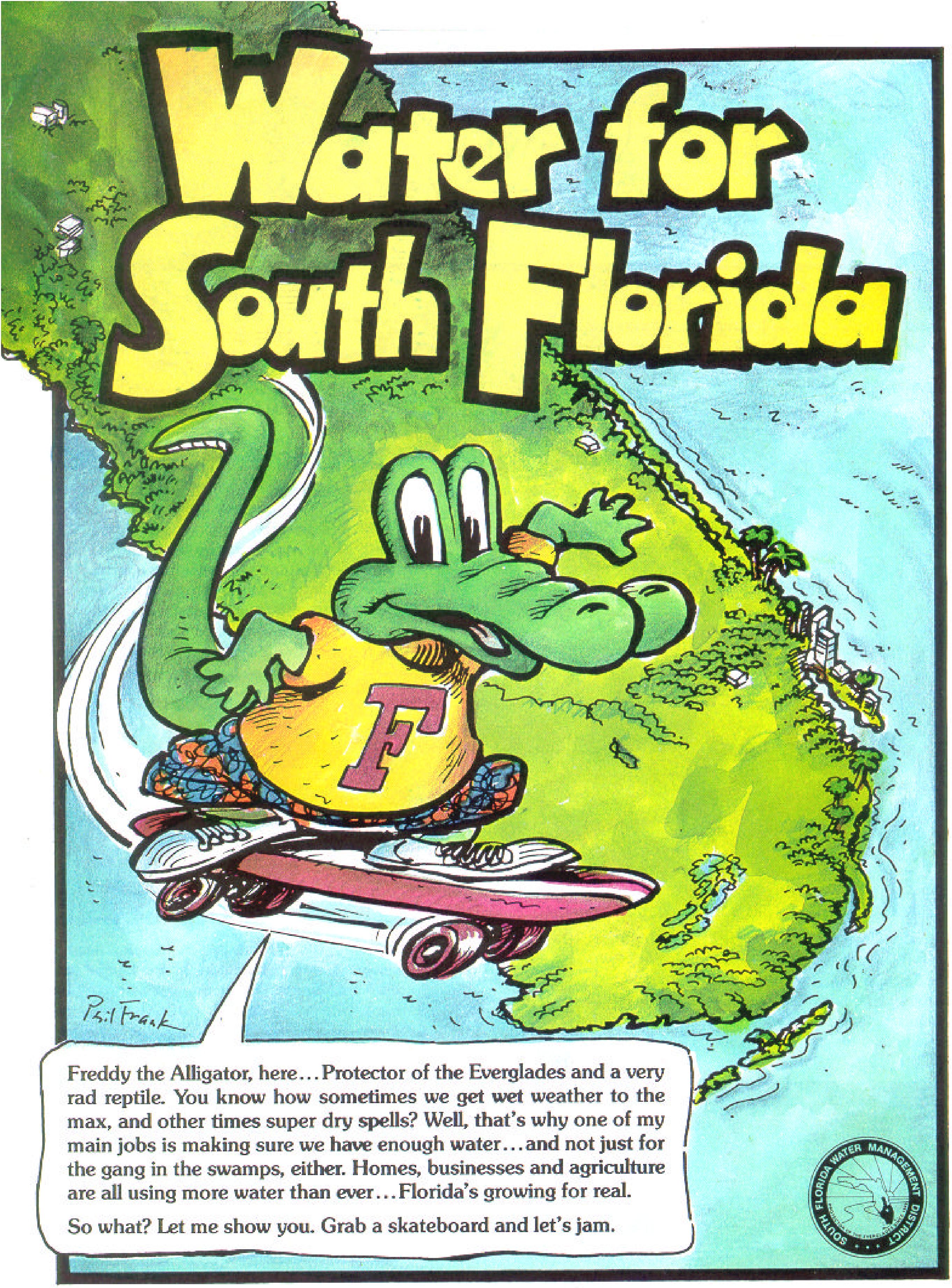
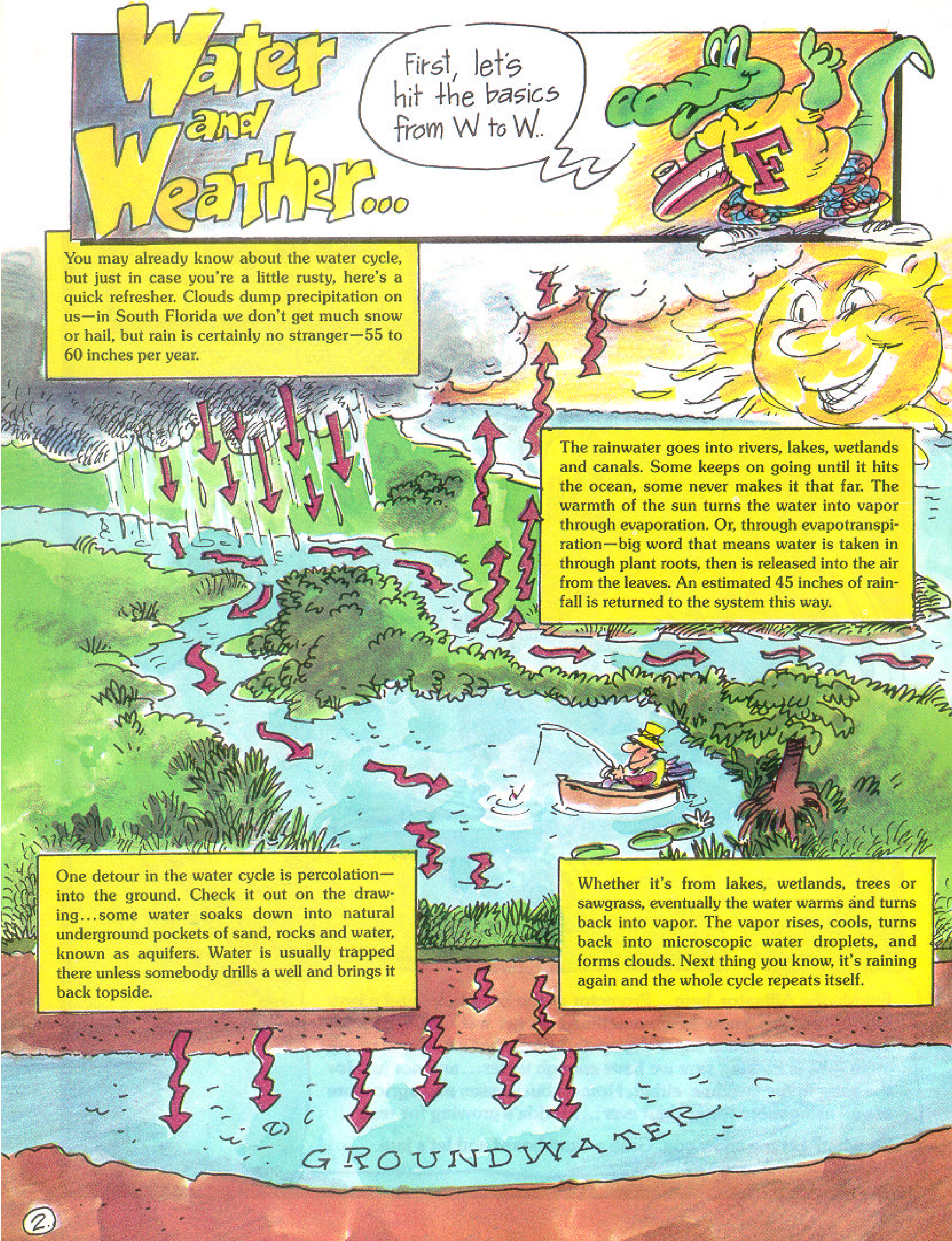

Water for South Florida
Phil Frank
Freddy the Alligator, here... Protector of the Everglades and a very rad reptile. You know how sometimes we get wet weather to the max, and other times super dry spells? Well, that's why one of my main jobs is making sure we have enough water...and not just for the gang in the swamps, either. Homes, businesses and agriculture are all using more water than ever... Florida's growing for real.
So what? Let me show you. Grab a skateboard and let's jam.
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Water and Weather...

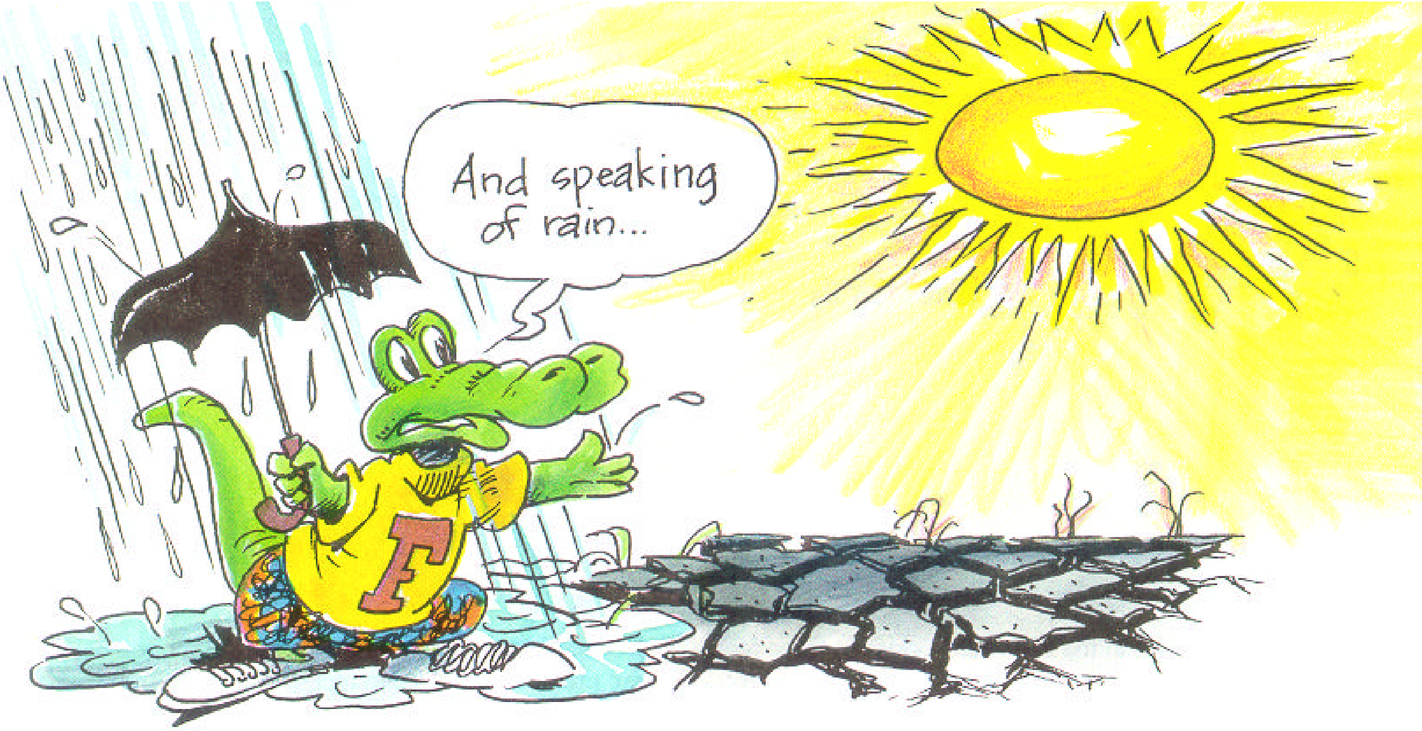


You may already know about the water cycle, but just in case you're a little rusty, here's a quick refresher. Clouds dump precipitation on us—in South Florida we don't get much snow or hail, but rain is certainly no stranger—55 to 60 inches per year.

The rainwater goes into rivers, lakes, wetlands and canals. Some keeps on going until it hits the ocean, some never makes it that far. The warmth of the sun turns the water into vapor through evaporation. Or, through evapotranspiration—big word that means water is taken in through plant roots, then is released into the air from the leaves. An estimated 45 inches of rainfall is returned to the system this way.

One detour in the water cycle is percolation—into the ground. Check it out on the drawing...some water soaks down into natural underground pockets of sand, rocks and water, known as aquifers. Water is usually trapped there unless somebody drills a well and brings it back topside.

Whether it's from lakes, wetlands, trees or sawgrass, eventually the water warms and turns back into vapor. The vapor rises, cools, turns back into microscopic water droplets, and forms clouds. Next thing you know, it's raining again and the whole cycle repeats itself.



They call Florida the Sunshine State. But, if you've been here more than a few hours, I don't have to tell you that one thing South Florida knows is rain. See, weather around here changes a lot from place to place and year to year.

During our rainy season from June to October, they'll usually get from 10 to 15 inches more of rain down around Miami than they will up along the Kissimmee River. And in our dry years, we'll get less than half as much rain as in our real wet years.

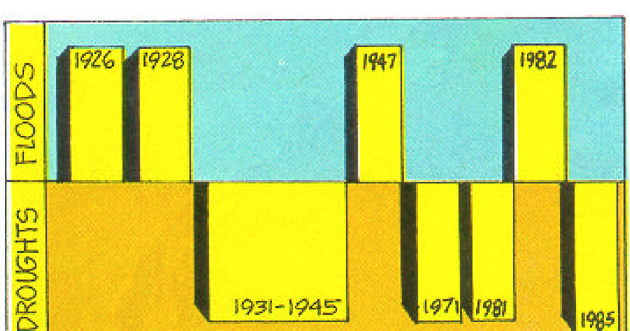
So it's no wonder that we have been known to go from floods to droughts very quickly. Furthermore, we have the extra added attraction of hurricanes, which can really spoil your day, and sometimes a whole lot more.

But, as I said before, you never know when the weather might change from mega-rain to big drought. And even the best weather forecaster can't say for sure what's coming next more than a few days in advance.

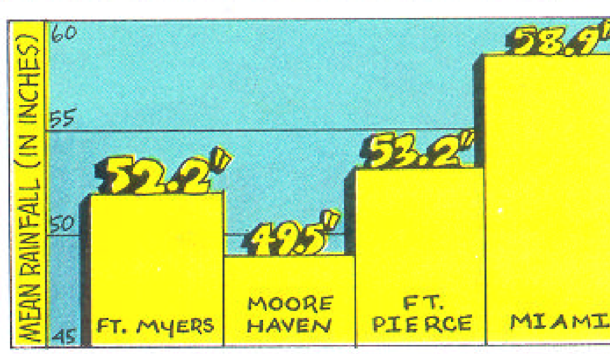
Then, think about all the new people and new businesses in South Florida over the last few years. You can see why there's so much talk about having enough water down here, especially since we all want to protect the natural beauty of South Florida, as well.

But that's another story I'll get to later. Here are a couple of charts to give you a feel for the areas where we get the most rain, and the years when we've had unusually high or low rainfall.

Wet and Dry Years



Regional Rainfall



Where does all that rain go?

Most of it comes in the summer — close to three feet of rain. In the winter there's a little more than a foot.

When the rain falls on the land, some of it runs off into bodies of water. These can be streams, canals, lakes, bays or wetlands. More about them later. The direction the water runs in depends on the slope of the land. If the land slopes toward the west, that's the way the water runs, and so on.

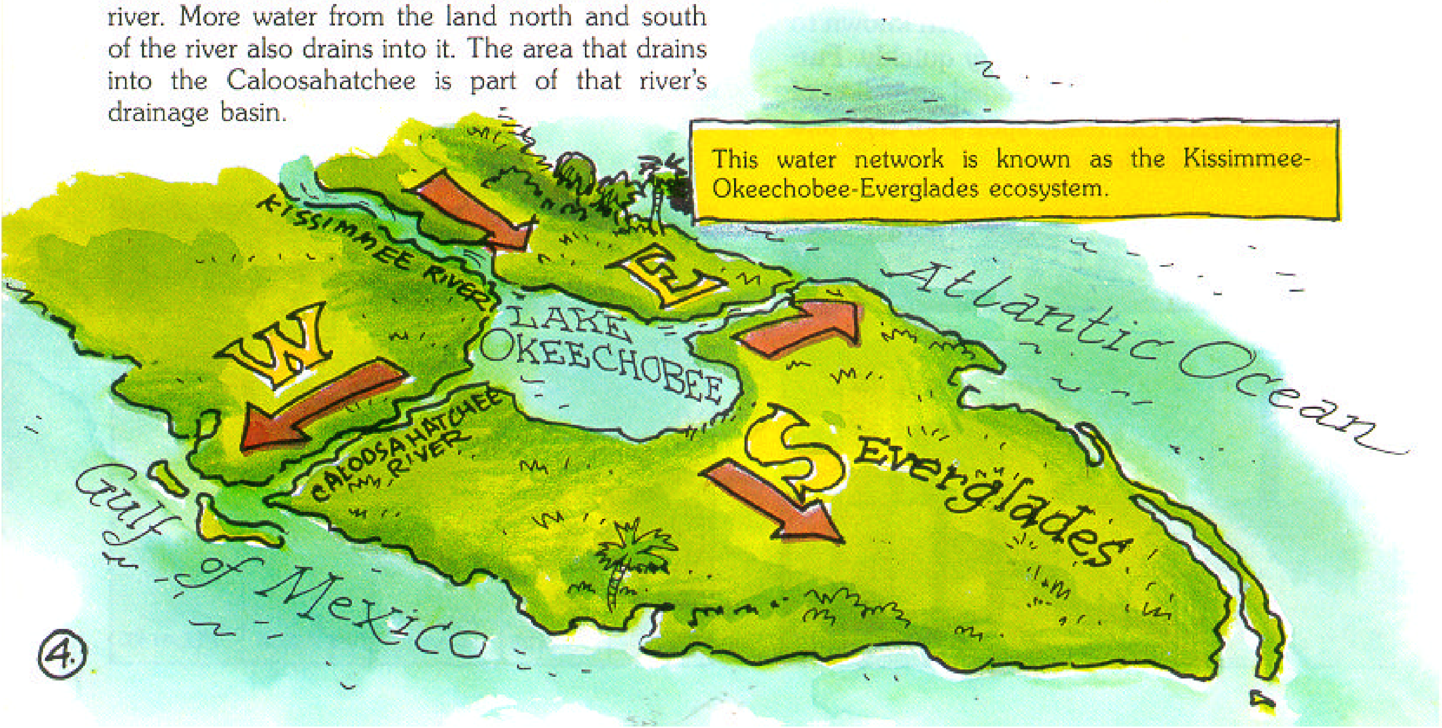
Even though our part of the state is pretty flat, there are still some slopes. They send the water on its way downhill. Here in South Florida, most of the water runs south, and east or west.

The areas that the water flows into are called drainage basins. One example of a drainage basin is the Caloosahatchee River Basin. Some of the water from Lake Okeechobee flows west into this river. More water from the land north and south of the river also drains into it. The area that drains into the Caloosahatchee is part of that river's drainage basin.

Because we are so flat, most of our drainage basins are pretty spread out. In fact, most of the area south of Lake Okeechobee is one big drainage basin. It includes the water conservation areas and the Everglades.

Lake Okeechobee is part way between the Gulf of Mexico and the Atlantic Ocean. The land slopes downwards from the lake towards the coasts. That's why water from the lake runs in three directions:

- West, towards the Gulf of Mexico, in the Caloosahatchee River;
- East, towards the Atlantic Ocean, in the St. Lucie River, and in canals;
- South, towards the Everglades, through a network of canals and marshlands.



Down into the Ground...

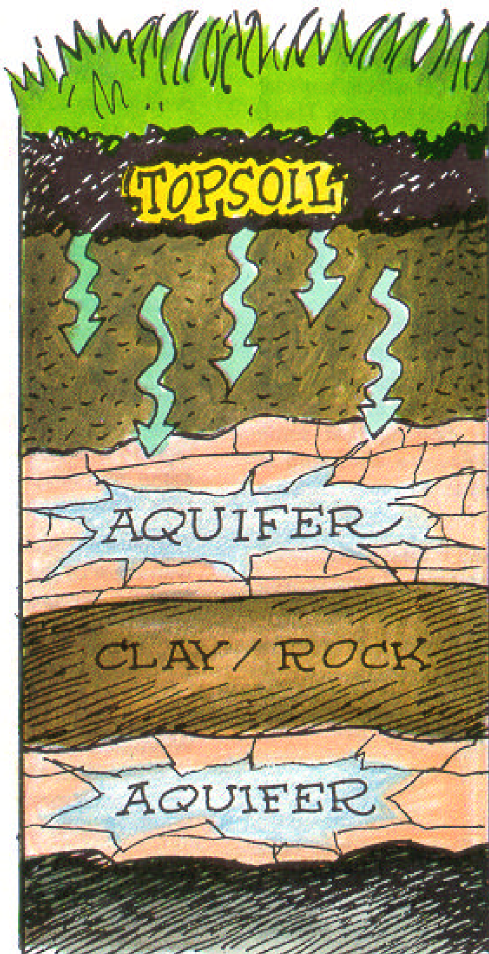
Now that we've seen what happens to water above the ground, it's time to go down below. Yes, there's water under the ground. And it's called groundwater. Pretty clever name, huh?

Groundwater comes from surface water that trickles down into the earth. Sometimes what happens is that rain soaks into the ground. Other times the rain flows into streams, lakes and marshes, then soaks in.

Along the surface of the ground is topsoil. Most people just ca'' it dirt, and it is made up of sand, clay and rocks, plus decayed plant matter from things like leaves and grass that have died and gotten mixed in with the soil.

When water first soaks into the ground, it goes into this layer of soil. People in the water business say that water percolates into the soil. It soaks down into underground rock formations called aquifers. This is where the water collects, and where we collect most of our groundwater.

Aquifers can be fairly close to ground level, or buried hundreds of feet deep. The area along the top of the aquifer, closest to the surface of the ground, is known as the water table. If somebody says the water table is 100 feet, you know that's how deep you have to drill to find an aquifer in that spot.



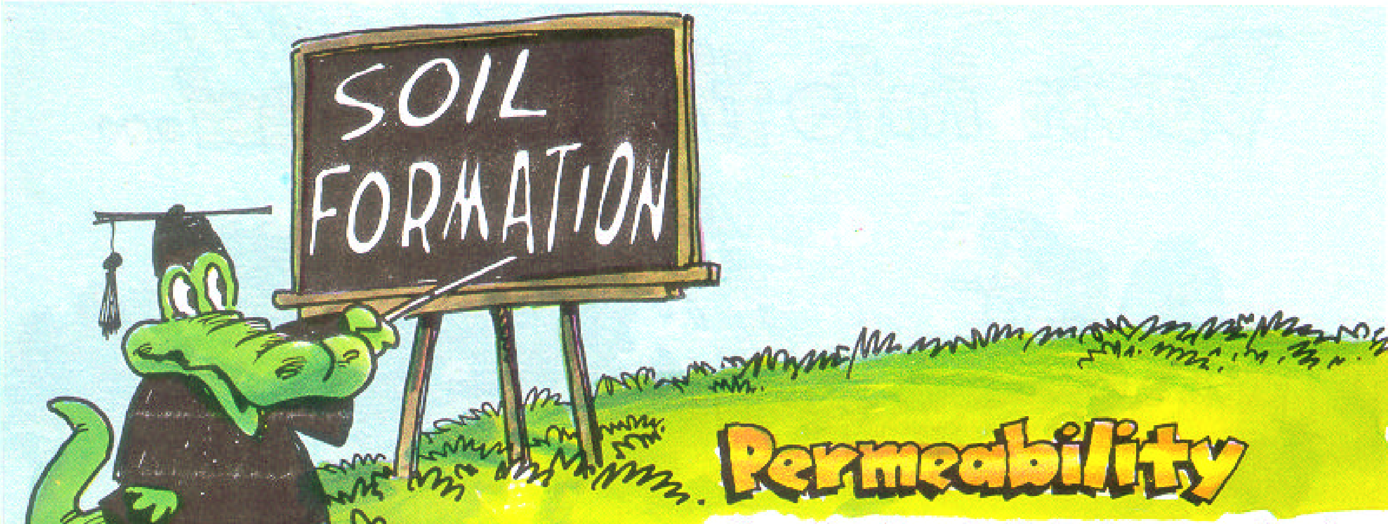
In many parts of South Florida there are two or more aquifers — one close to the surface and another one deeper in the ground. Usually a layer of rock or clay separates aquifers.

Sometimes underground spaces form in aquifers — and water collects in these openings. These underground cavities are called caverns. Once in a while when water is pumped out of these caverns, the weight of the ground above makes them collapse. If the ground above sinks down into the cavern, a depression can form on the surface above. This is called a sinkhole.

Usually, the way we get water from aquifers is to drill a well. In fact, in our end of the state most of the water we use comes from wells. You may have seen a well being dug. The drilling rig used to dig wells cuts a hole in the earth, usually smaller around than a telephone pole.

The rig brings dirt up out of the ground, creating a shaft. Well drillers line the shaft with pipe to keep soil and polluted water from getting into the aquifer. Then a waterproof electric motor is lowered into the well to pump the water to the surface.

Wells can produce anywhere from a few thousand gallons of water per day up to several million gallons.



Remember I said that there are two or more aquifers under the ground in some parts of South Florida? Well, the reason for that is what they call soil formation. Let me explain.

Soil and rock formations are found in layers in South Florida. Close to the surface in many areas are what we call surficial aquifers. These are the ones that are easiest to reach. Then, deeper in the ground, sometimes you'll find another aquifer.

In Florida, aquifers are made up mostly of two types of material. One is sand. The surficial aquifers are examples of sandy aquifers. We find water in these sandy underground deposits because sand is not solid and there is space for the water to collect.

The deeper aquifers usually are made of limestone. This is a kind of rock that has lots of spaces in it where water can collect. Limestone is interesting stuff because it dissolves slowly in water. That's part of the reason why there are so many spaces in the limestone. Remember reading that some aquifers have caverns? Well, usually caverns are found in limestone aquifers, because the limestone dissolves, creating the openings.

Limestone is also brittle, which means it cracks into small pieces. These cracks make it even easier for the water to seep into all the spaces.

There are two characteristics that make certain soils good for aquifers. The soil must be able to hold large amounts of water, and it must "give up" the water easily. Soils that have both of these characteristics are said to be porous and permeable.

Porosity

Porous soil is material that has a lot of spaces in it to hold water. Porosity is based on the size of the soil particles and on the spaces in between the particles. Sand, for example, is made up of fairly large grains with lots of spaces. We say sand has high porosity.

Another type of soil that has high porosity is clay, which has lots of particles with spaces in between. A hard rock is an example of a soil that isn't very porous, because there is very little space for water.

Permeability

Permeable soil is material that water can move through quickly. Once again, our old friendly sand has high permeability because water will flow right through it. Limestone is another material that is right up there in permeability. That's because of all the cracks that allow water to seep through.

On the other hand, while clay is porous, it is not very permeable. Imagine trying to pour water through a lump of clay — good luck! The problem with clay is that the soil particles are so fine that they are packed together too closely to allow water to pass through easily. Stuff that water can't pass through quickly, like clay and rock, is called impermeable.

If you could cut a slice deep through the earth, and look at it from the side, you would see layers of different kinds of soils that built up over millions of years. On the top would be — you guessed it — topsoil. Under that would be layers of rock, sand, clay or limestone. Exactly what you would find would depend on where you dug, because what's underground differs a lot from one area to the next.

Aquifers are the layers of porous, permeable material, like sand and limestone. The water in an aquifer stops soaking deeper into the ground because of an impermeable layer of some kind directly under the aquifer. This could be clay or rock. These impermeable layers are called confining units.

Aquifers are really important to us because they supply us with most of the water we use in South Florida — about 90 percent. But those aquifers don't have an endless supply of water. The amount of water in the aquifers depends on rainfall.

Luckily, even though we keep pumping water out of aquifers, more water trickles down into them from rain or surface water. When new water replaces water which has been pumped out of an aquifer, they call it groundwater recharge. Rainfall is the most important source of recharge to the aquifer in South Florida.

It's important not to take too much water, because we can pump it out faster than nature can recharge it. And, if our aquifers were ever to go dry, we'd be in a heap of trouble.

Water gets into aquifers through open areas, called recharge areas. These are places where water gets into the aquifers after flowing through the ground. This is true with deep aquifers, too. At some point they are closer to the surface, and that's where they get recharged.

Freddy's Fabulous Soils Experiment

Here's how you can test various soils to see how porous and permeable they are. To do the test, we're going to put different kinds of soil into four empty soda bottles, and then try pouring some water through (it takes two people to do this).

Materials Needed:

One 4-cup measuring cup
One ruler
Three 2-liter, empty plastic soda bottles
Three screw-on caps for the soda bottles
Three 2-inch by 4-inch pieces
of window screen
Nine small stones (about 1/2

Six cups of sand
Six cups of topsoil
Six cups of dry clay

To start with, screw the caps on the three bottles. Cut the bottom two inches off of each bottle. Fold each piece of screen over so that it is two-inches square.

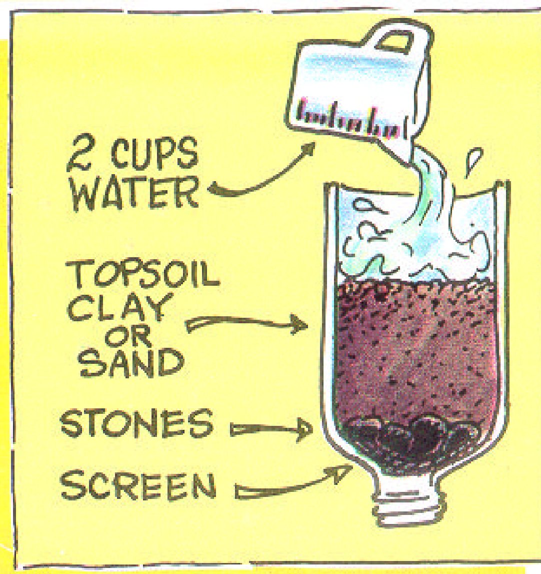
Now, one person holds one of the bottles upside-down. The other pushes one of the pieces of screen into the neck of the bottle to keep the soil from coming out of the neck, then puts three of the small stones on top of the screen. Then pour the topsoil into the bottle.

Next, put two cups of water into the measuring cup, then pour it into the bottle that has the topsoil in it. Wait one minute for the water to soak in. If there is any water standing above the top of the soil, measure it with the ruler and record the results in the space below.

Now, placing the measuring cup under the bottle, unscrew the cap and let the water drain into the cup. After one minute, put the cap back on the bottle and set it aside. Read the amount of water in the measuring cup by using the marks on the side of the cup. Record the results in the space below.

Repeat the process with the other two bottles (take turns with who holds the bottle). Use a different soil sample for each bottle. Use three cups of water for each sample, and wait one minute before each measurement.

After you do the clay, save the bottle with the water still in it. Keep it over night, then repeat the measuring steps again the next day. Was there any difference?



What can you learn from all of this? Well, the amount of water standing above the soil after one minute (your first measurement) gives you an idea of the porosity of the soil sample. The more water standing, the less porous the soil (don't forget that you checked the clay twice).

The permeability of the soil was shown by how much water went into the cup after removing the cap. Which of the soils released the water most readily? That one was the most permeable. The one that released the least water was the least permeable.

TYPE OF SOIL	Inches of water above top of soil	Ounces of water drawn out of bottle
Bottle with TOPSOIL		
Bottle with SAND		
Bottle with CLAY		

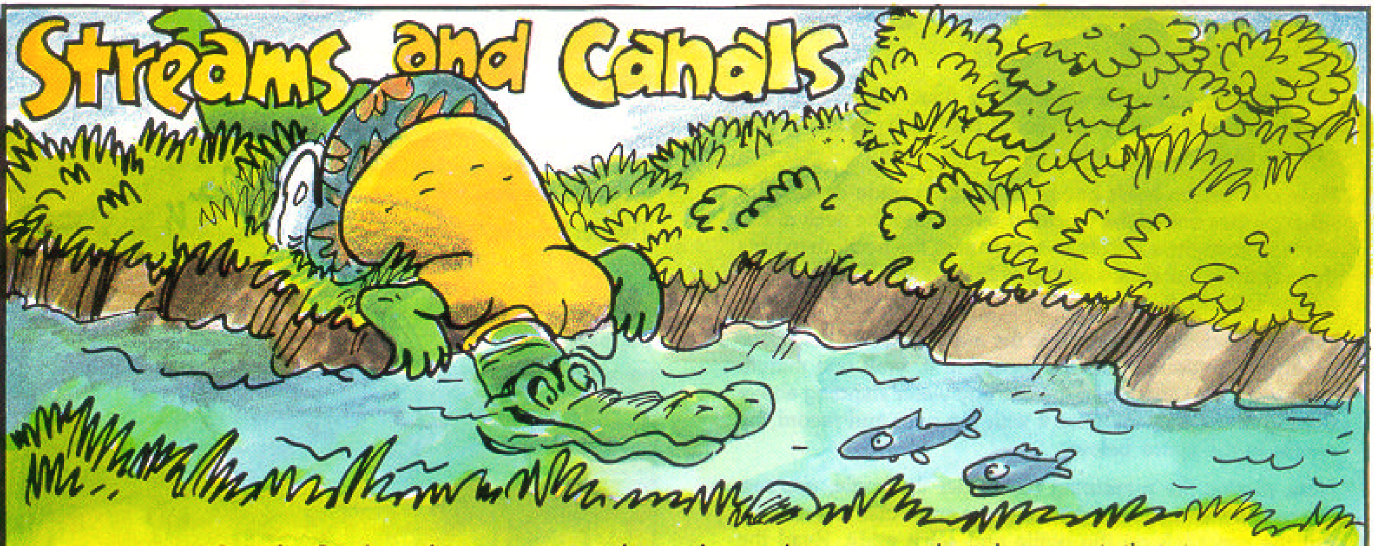
Water and the Land

Even though we get most of our drinking water from underground, it started out as rain on the surface. If South Florida were one big parking lot, the water wouldn't soak into the ground and the groundwater wouldn't be there for us when we needed it.

What's the point? Well, think about it. All the bodies of water we see on the surface are important to our water supply. From them comes a lot of the water that recharges our aquifers. And, my friends, those bodies of water are also important to the fish, birds and other wildlife — like yours truly! So let's check out the surface waters of South Florida.

We've already learned about drainage basins. But where does all that water drain? Well, if it doesn't soak into the ground then it runs into some kind of body of water.

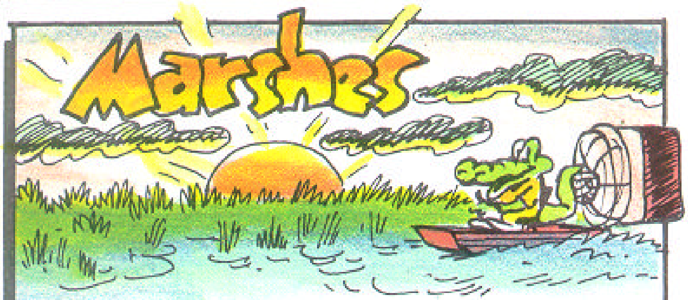
Streams and Canals



Streams and **Canals**: Creeks and rivers are examples of streams. They move water from one place to another. Streams are also home to little water creatures and fish that are food for birds and other animals.

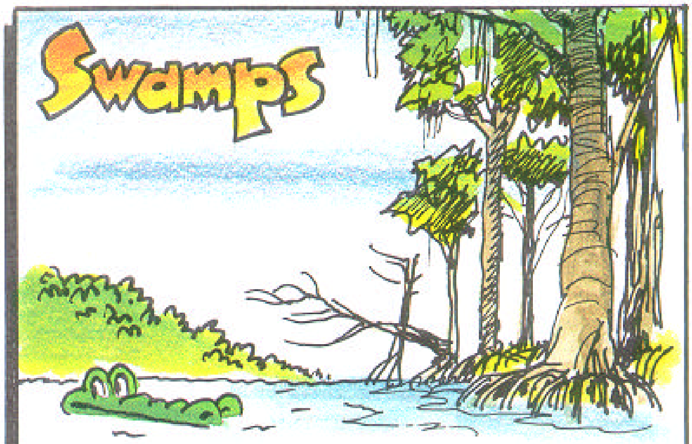
People-made channels that move water from one place to another, or hold water, are called canals. The difference between canals and streams is that streams are created naturally. Canals have to be dug. People in the water business build canals to get water to places where it is needed. They also dig them to move water out of areas where floods occur.

Lakes: You probably have a lake where you like to go fish, swim, boat or have a picnic. A lake is a body of water surrounded by land. Lakes can be natural or man-made. In South Florida we have lots of man-made lakes. They're swell places for all kinds of animals and fish. Lakes also store water that helps keep streams flowing during dry months. Small lakes are called ponds.

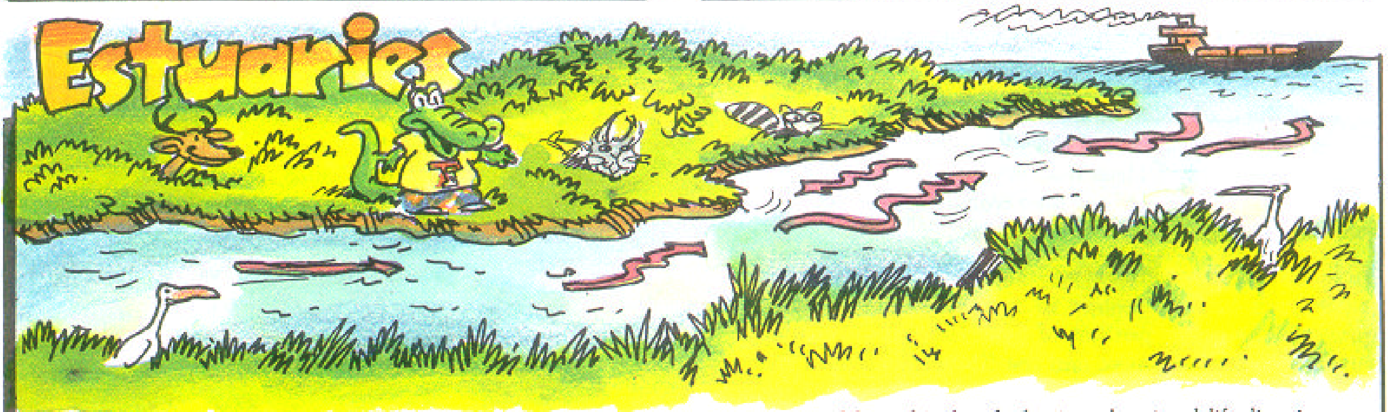


Wetlands: Areas that are under water for a lot of the year are called wetlands. The main thing that controls life in wetlands is water. There are two main types of wetlands — marshes and swamps. Here's the difference.

Marshes: A marsh is a fairly flat wetland. There are freshwater and saltwater marshes. Marshes have many grasses but only a few trees. Marshes are important because all those roots stop soil from washing away. The grassy plants also filter out pollution, so marshes help keep our streams and lakes clean, too. Healthy marshes are so full of life they are like bird heavens — because of all the food they find there.

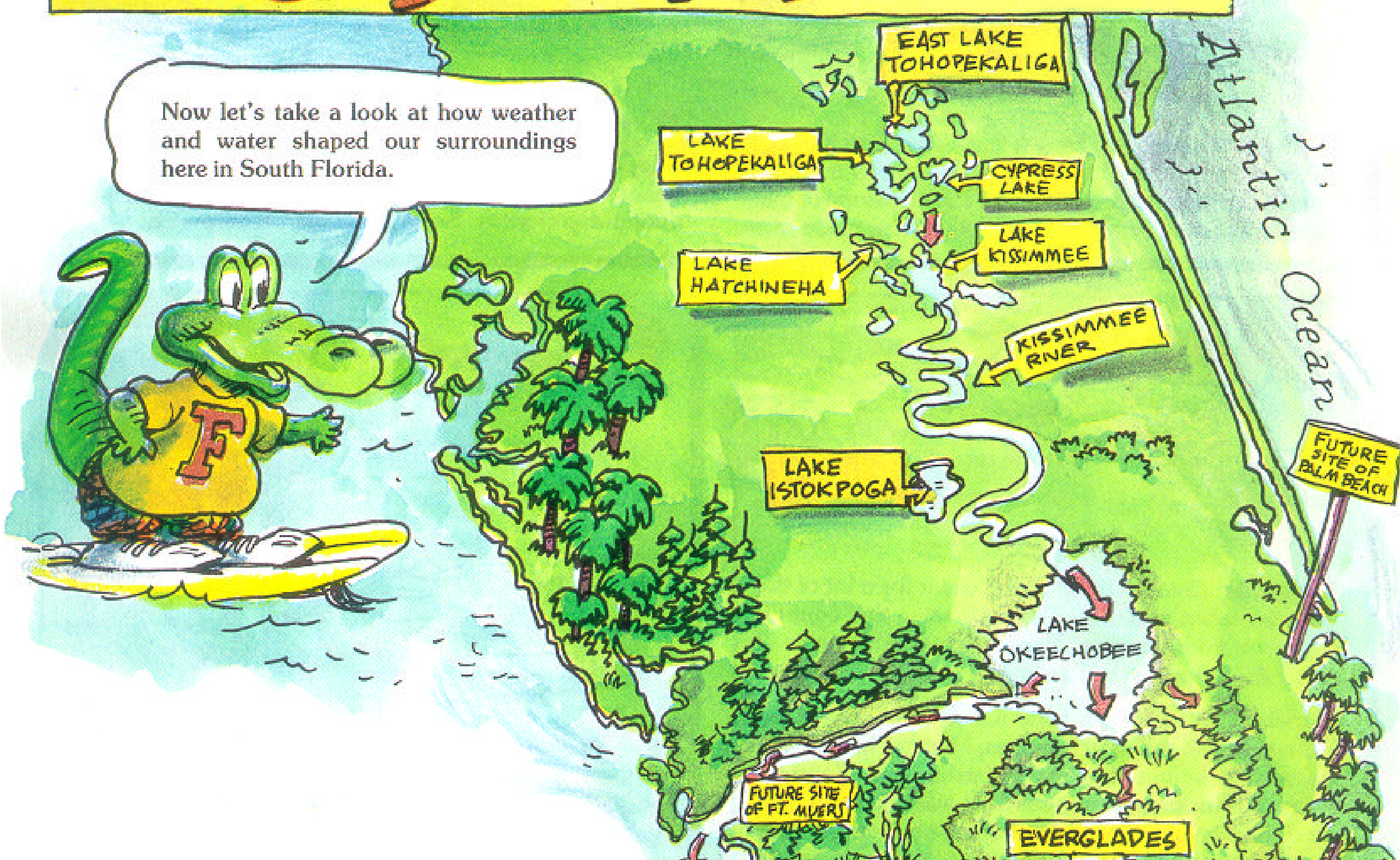


Swamps: A swamp is another type of wetland — not as flat as a marsh. The big difference between a swamp and a marsh is the type of plant life there. In a swamp you'll find lots of trees, like cypress, mangroves, palms and pines. Swamps are great places to find all kinds of interesting animals, like bears, deer, racoons and, of course, alligators.



Estuaries: An estuary is an inland area where the fresh-water from the land meets the saltwater from the sea. Water in estuaries has some salt, but not as much as sea water. Many kinds of plant and animal life live in estuaries, including bobcats, racoons and deer.

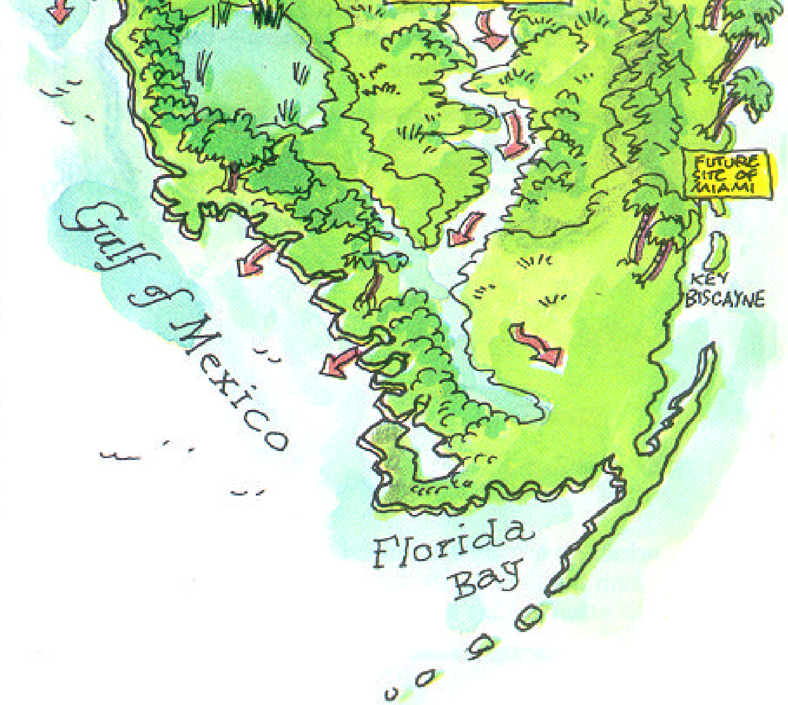
The Natural Water System of South Florida



Before there were any Indians, settlers or any other people here, the land had already been carved out by nature. There were droughts and fires, hurricanes and floods, and each played its role in modifying the land that was here when the first people arrived.

South Florida is flat. The land along both coasts and most of the land south of Lake Okeechobee is less than 25 feet above sea level, and elevations throughout South Florida are nearly all less than 50 feet above sea level. Consequently, much of the area was a combination of part land and part sea or fresh water.

Before people arrived, and pretty much still today, there were three major features to South Florida's water picture. The upper portion of South Florida is made up of a number of lakes and the Kissimmee River. In the middle is Lake Okeechobee. The lower portion has the Everglades.



Kissimmee River System

There were many lakes in this area of what is now Highlands, Orange, Osceola and Polk counties. Some of the bigger lakes include Lake Tohopekaliga and East Lake Tohopekaliga on the north, Cypress Lake, Lake Hatchineha and Lake Kissimmee. Some of the water from these lakes eventually made its way into the Kissimmee River.

The river wandered back and forth across the Kissimmee Valley on its way from Lake Kissimmee to Lake Okeechobee. Although a straight-line route between the two lakes is about 52 miles, the Kissimmee River, with all its meanders and oxbows, took almost 98 miles to make the trip.

The river wound through very extensive marshes for a good portion of its route down its one-mile-wide floodplain. During the rainy season, the flooded marshes teemed with large numbers of fish and smaller water creatures. As water levels fell during the dry season, these aquatic organisms were concentrated into smaller areas. Larger fish, birds and alligators preyed heavily upon the concentrated masses of aquatic animals.

Lake Okeechobee

Okeechobee was and is one big lake. Created without any help from human dam builders, Lake Okeechobee is the second largest natural freshwater lake wholly within the United States (Lake Michigan is the largest). Because the lake is shallow (average depth is 9 feet) and spread out over an area of 730 square miles, a lot of water escapes from the surface straight into the air through evaporation.

In its natural state, Lake Okeechobee had no barriers or controllable outlets to hold back the flows caused by heavy rainfall. So, water would sometimes overflow its southern rim, inundating the flat land with shallow, slow-moving sheets of water.

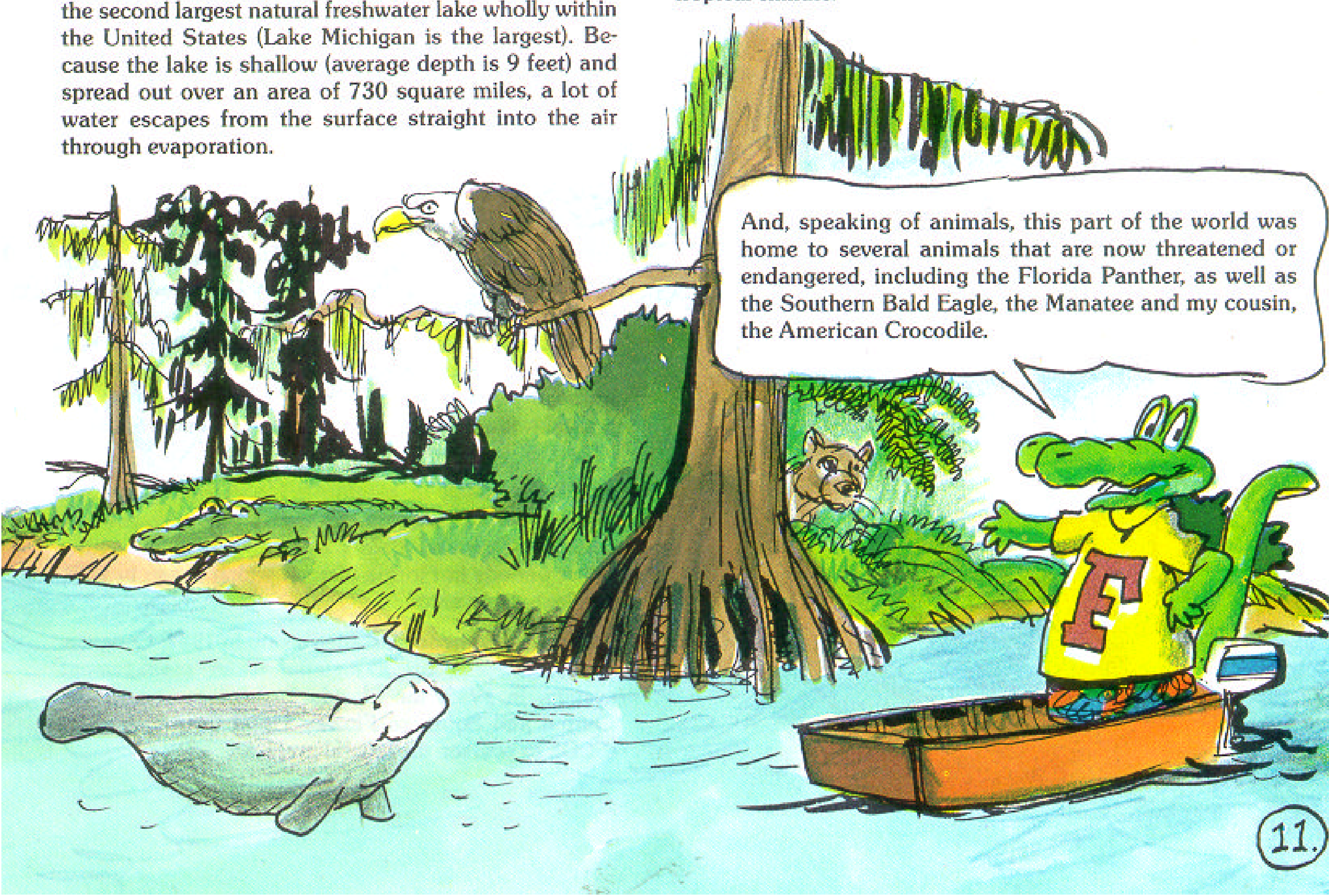
The Everglades

Even bigger than Lake Okeechobee was the original Everglades – the vast expanse of sawgrass, tree islands, sloughs, marshes and cypress forests that spread across most of the southeast part of what is now Florida.

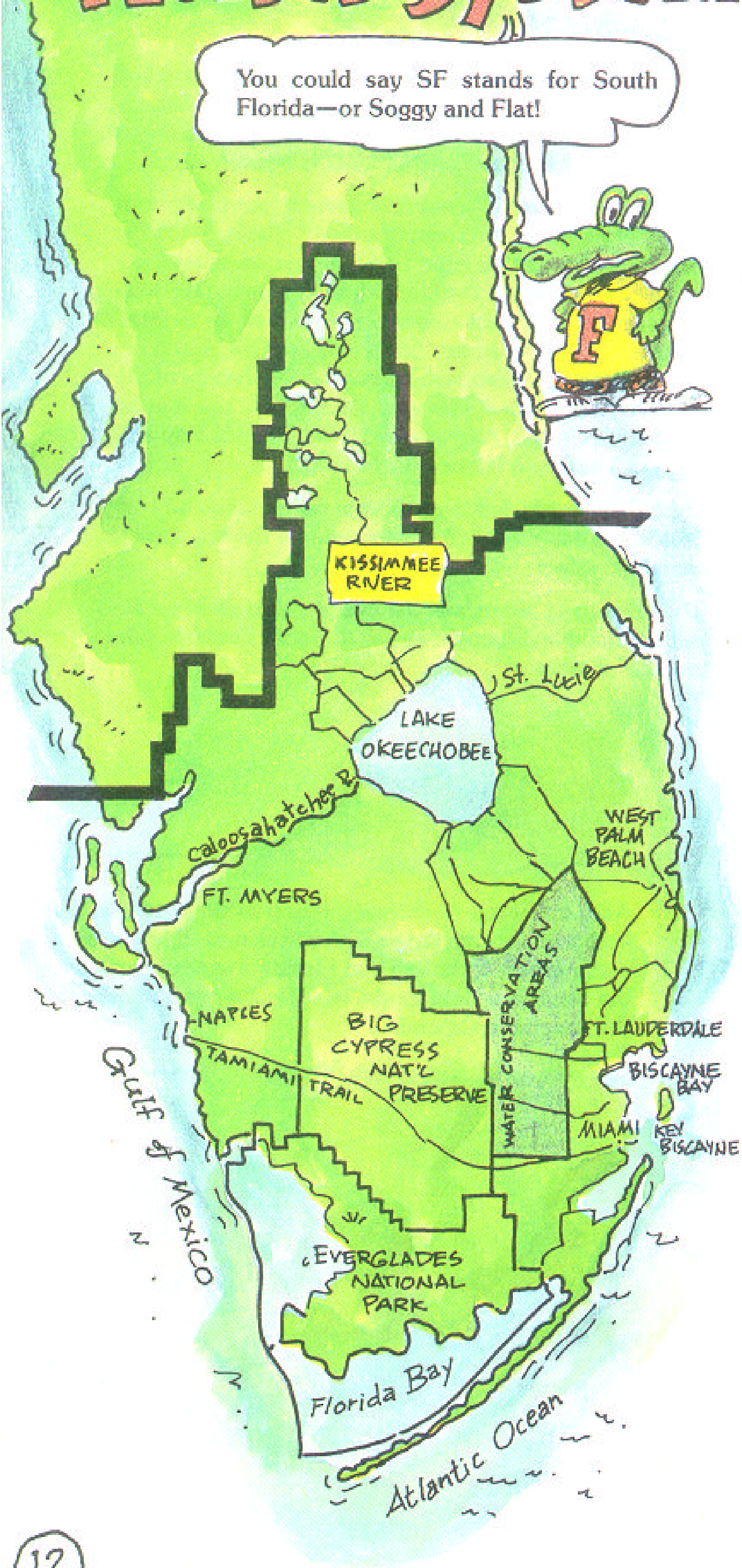
When there were only animals around, we thought of the Everglades as a "river of grass." Water gradually flowed down, mostly from rains, in one wide, continuous blanket through the plants growing out of the low-lying lands. The native vegetation served as a filter, cleansing the water of any harmful impurities. Along the way, some of the water was taken in by the roots of the plants and released into the air through the leaves. Some evaporated. And some reached Florida Bay and the Ten Thousand Islands to the south.

During dry spells, lightning storms would touch off vast fires in the marshes. Still, the integrity of the eco-system remained intact.

The plants and animals of the Everglades thrived on the natural flood-and-drought cycles of South Florida's subtropical climate.



South Florida's People-made Water System



I wouldn't be surprised if the first people to set foot here turned around and went back where they came from—South Florida in its natural state was great for us animals, but not so hot for people.

Because of the rain and flat terrain, many of the places in South Florida where people live today were under water for at least part of year.

Shortly after Florida became a state in 1845, Congress passed the Swamp Lands Act of 1850. This law made all swamp lands the property of the state, and was the first move in getting the land dried out so people could use it.

In 1881, a Philadelphian named Hamilton Disston saw a chance to make some money on bargain-priced Florida land. For 25 cents an acre, he bought four million acres of land from the state and began large-scale drainage by building an outlet from Lake Okeechobee to the Gulf Coast via the Caloosahatchee River. He also built canals connecting some of the lakes in the Upper Kissimmee area, providing additional drainage and allowing boats to navigate between lakes.

Disston's was the first large-scale, regional drainage project; he proved that while such undertakings were both complicated and expensive, they were possible. His success attracted world attention to Florida.

In 1907, the Everglades Drainage District was created to drain the area south of Lake Okeechobee by drawing off excess water via canals to the Atlantic Ocean. Six major canals, 440 miles of levees and 16 locks eventually were built between Lake Okeechobee and the Atlantic. They lowered water in the Everglades and created habitable land from Palm Beach to Miami.

Another major development was completion of a railroad in 1912 from Jacksonville to Key West, further opening up the area. As new population moved in, local water systems were developed, relying mainly on wells and underground water supplies. This set the stage for a problem in future years. Fresh water taken from the ground was starting to be replaced by salt water moving inland from the ocean.

Nature persisted in playing fickle drought-and-flood tricks on South Florida. Severe flooding from hurricanes in 1926 and 1928 was followed by one of the driest periods in Florida history, which began in 1931 and lasted 14 years.

Following another devastating storm in 1947, Congress approved plans for a regional water management system. In 1949, the Florida Legislature created the Central and Southern Florida Flood Control District (FCD), to oversee the federal project.

The major components of the flood control project included:

—construction of a levee around Lake Okeechobee to prevent a recurrence of disasterous hurricane-driven wind tides and to increase the lake's storage capacity.

—a network of 1400 miles of canals and levees. Flow of water in the canals is regulated by more than 125 water control structures and 18 pumping stations which have a combined capacity of more than 20 billion gallons per day (20,704,005,900).

—saltwater intrusion barriers at the seaward edge of each canal.

—creation of three water conservation areas to store water for both flood control and water supply purposes, and to recharge the underground aquifer system. The conservation areas preserve almost 50 percent of the original Everglades in a wilderness state.

—channelizing the natural curves of the Kissimmee River to provide flood protection in the Kissimmee River Basin.

But all these projects proved to be mixed blessings. In addition to providing flood control, water supplies and land, people-made projects had produced some significant impacts on the environment.

In 1972, Florida passed the Water Resources Act which broadened the authority and responsibilities of the existing FCD, and created four other regional water control agencies in the state. The FCD was renamed the South Florida Water Management District in 1976, to more accurately reflect its new functions.

Today, strong efforts are being made to balance programs and, where possible, return the environment more nearly to the condition it was in before the arrival of people.

Growing Water Needs

Place the following events on the timeline below and label them. Note the example of Florida statehood.

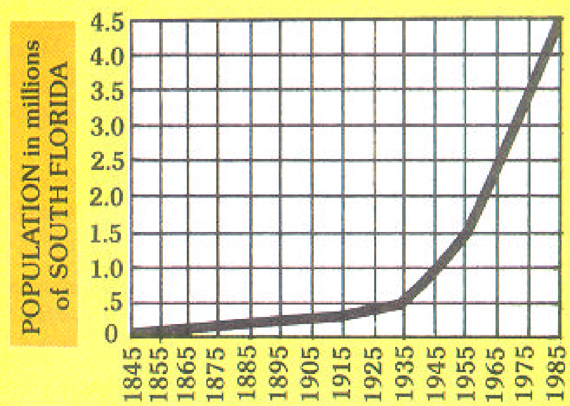
- Central and Southern Florida Flood Control District established.
- Everglades Drainage District created.
- Flagler railroad completed to Key West.
- Flood Control District renamed South Florida Water Management District.
- Lake Okeechobee outlet construction began.
- Beginning of 14 years of drought.
- Swamp Lands Act passed.
- Water Resources Act passed.

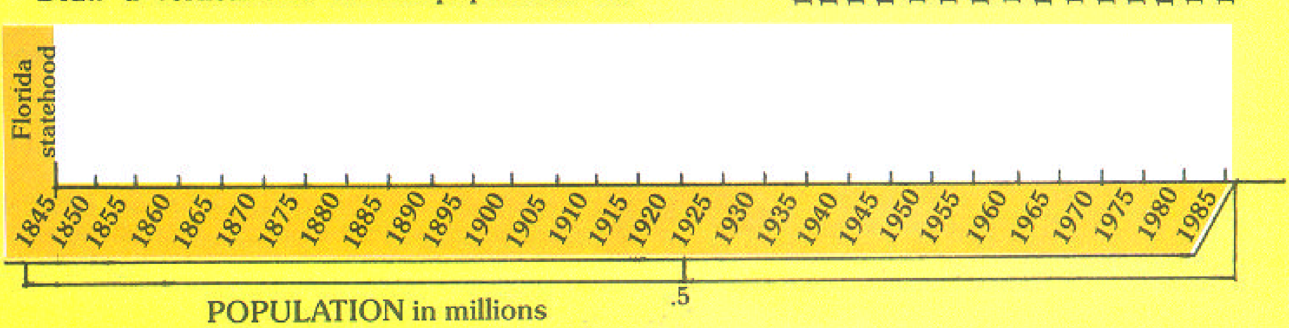
Study the South Florida population chart and answer the following questions:

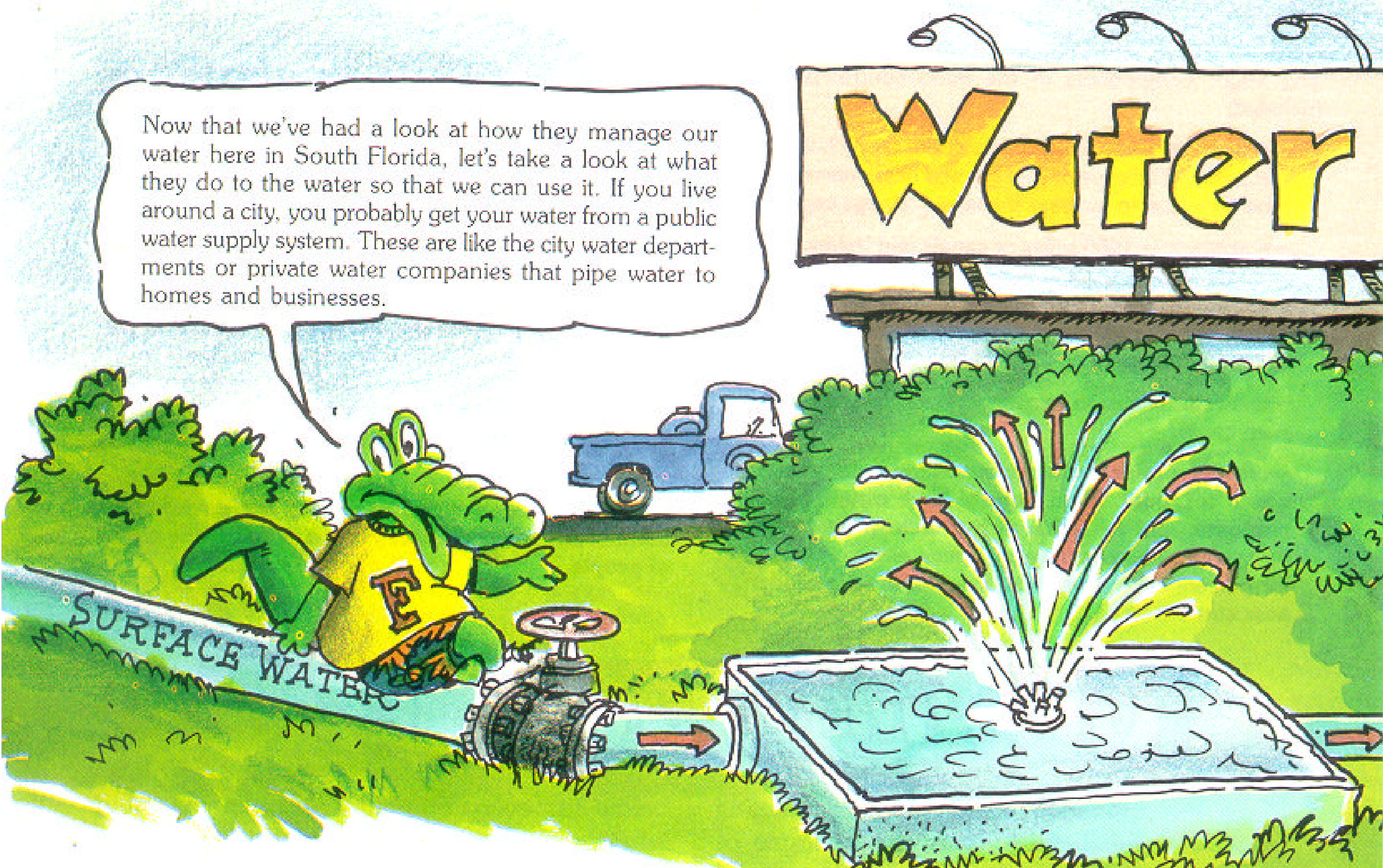
- In which year did the population reach 500,000? _______
- What was the population in 1955? _______
- In which year did the population reach 3.5 million? _______
- What was the population in 1985? _______

Draw a vertical line on the population bar below for every one-half million people and label the population at that point below the bar. Note the example of .5 million.

On a separate sheet of paper, write three conclusions that can be drawn from the information presented in the reading and the population chart. Explain how you arrived at your conclusions by citing the appropriate data.







These systems get their water from one of two places — large wells or surface water, like Lake Okeechobee.

In Florida, if you run a public water supply system, you have to treat the water you sell, to make sure that it's safe to drink.

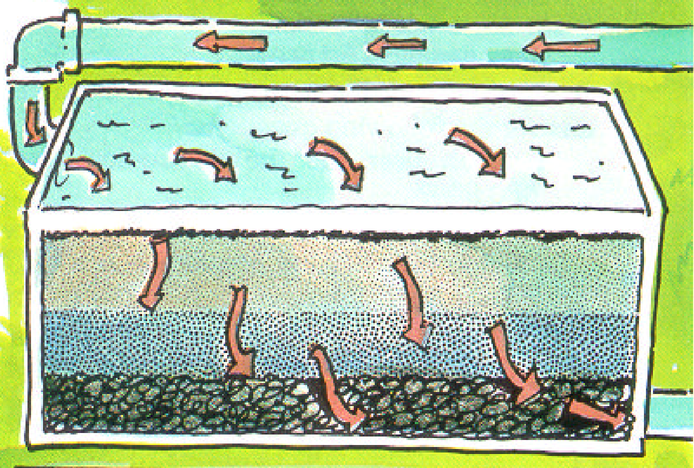
Systems that use groundwater for their supply usually put small amounts of chlorine in the water. The chlorine is a disinfectant, which means it kills any harmful microorganisms that might get in the water. Microorganisms are tiny life forms, like bacteria. Killing the microorganisms is usually all it takes to make groundwater safe to drink.

Surface water is a whole 'nother story. It needs a lot more treatment. That's because surface water collects sticks, dirt and other gunk off of the ground.

To clean up surface water, public water systems use water treatment plants. These are places where water is screened, filtered and treated with chemicals to remove any impurities. Getting all that stuff out is a much bigger process than just adding chlorine. Here's how they do it.

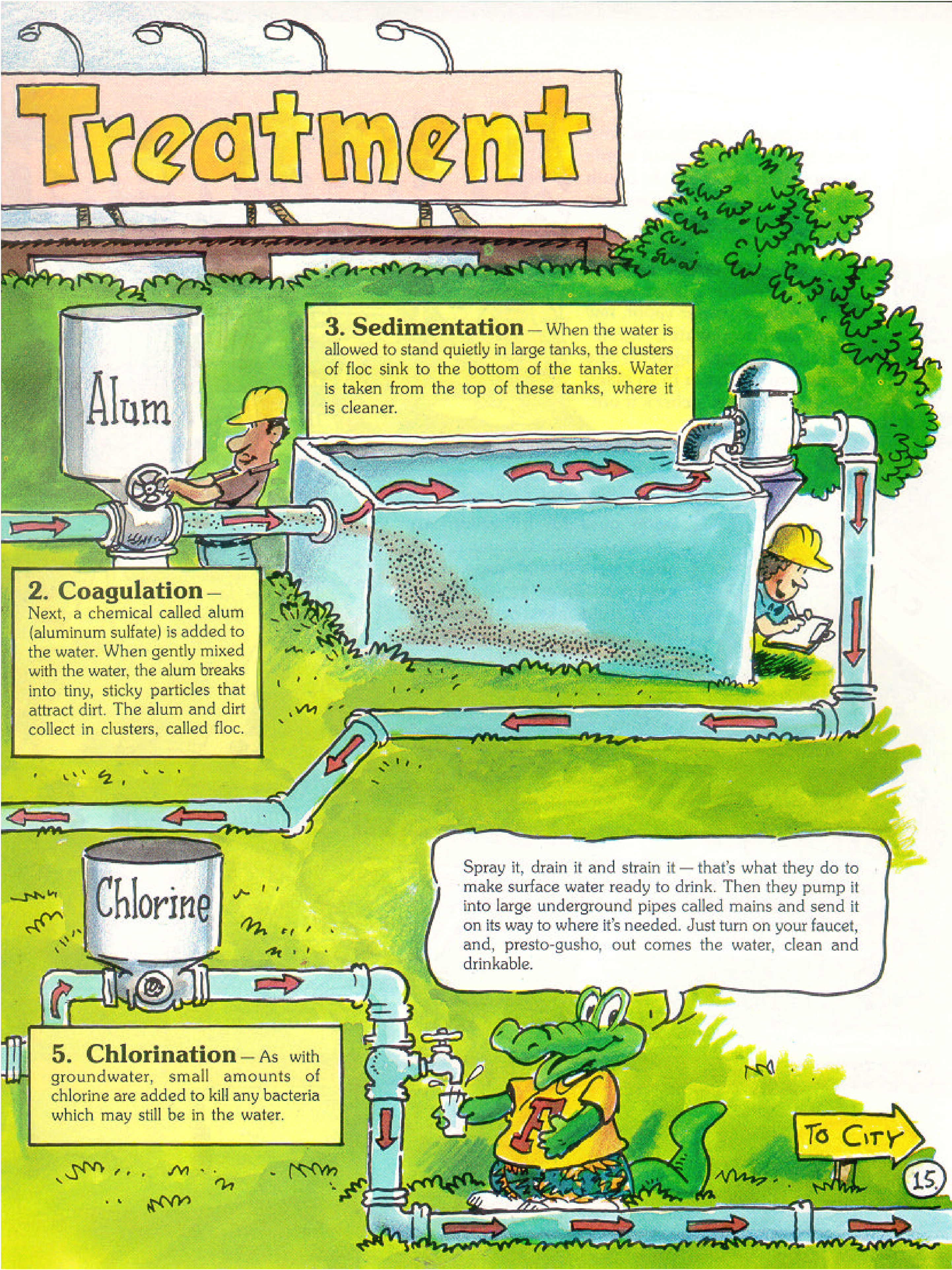
Usually at a treatment plant water will go through a five-step process.

1. Aeration — In this step the water is sprayed into the air to allow trapped gases to escape and to add oxygen from the air. Getting rid of trapped gases and adding oxygen make the water taste better.



4. Filtration — While water from the top of the tanks is cleaner, it still is not clean enough. So, they filter the water through layers of sand, gravel and rocks. The filters trap tiny particles that still are in the water.

Treatment

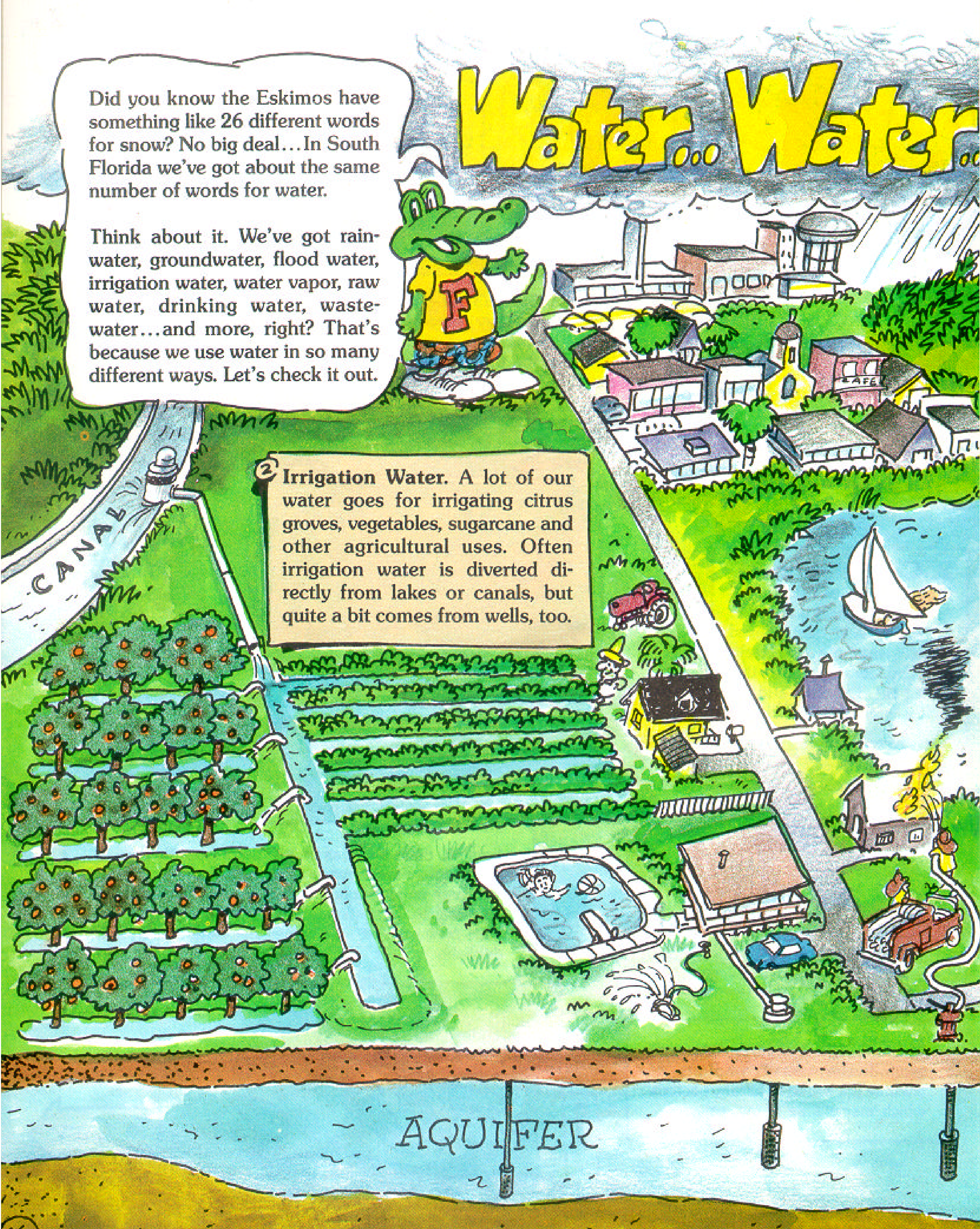


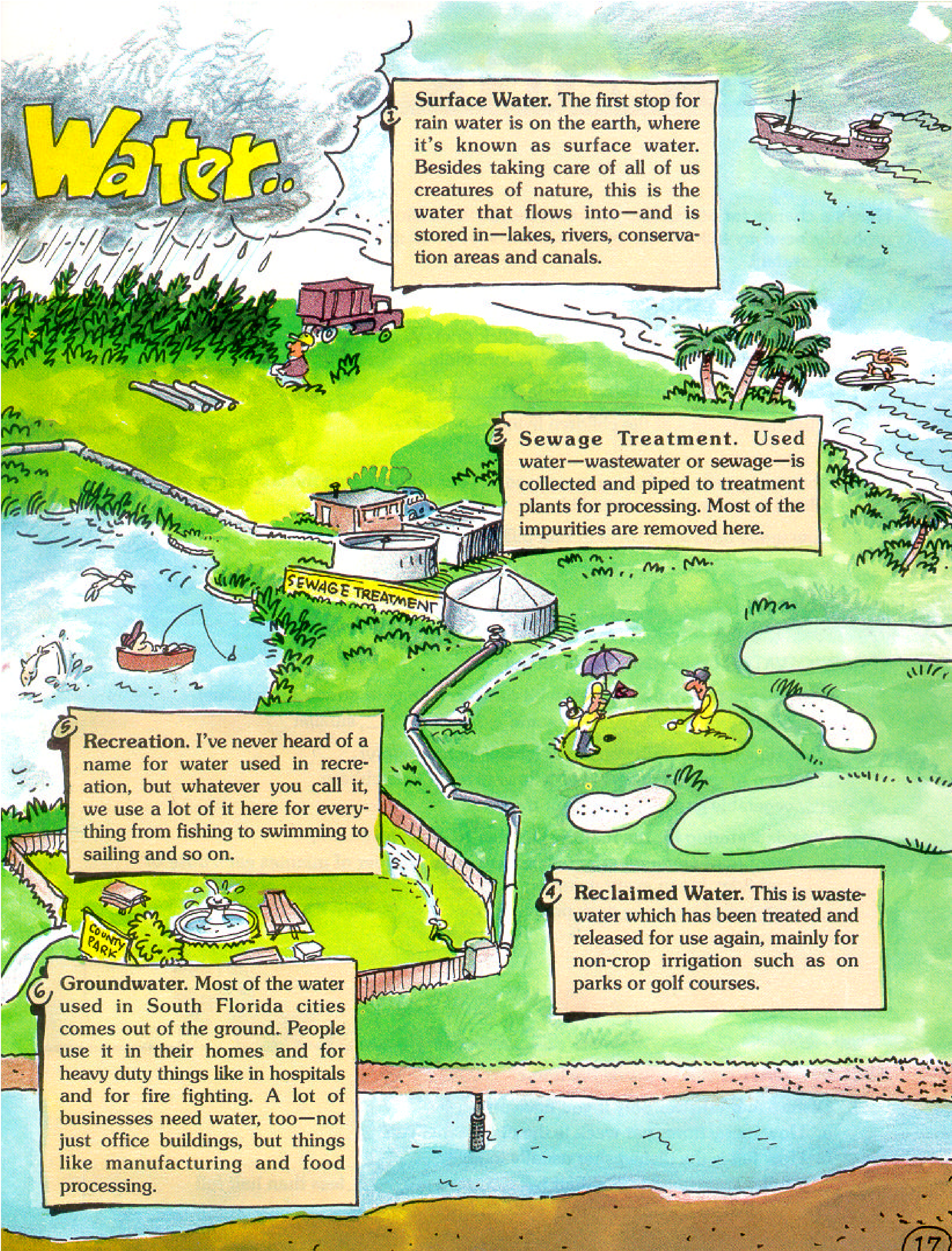
2. Coagulation — Next, a chemical called alum (aluminum sulfate) is added to the water. When gently mixed with the water, the alum breaks into tiny, sticky particles that attract dirt. The alum and dirt collect in clusters, called floc.

3. Sedimentation — When the water is allowed to stand quietly in large tanks, the clusters of floc sink to the bottom of the tanks. Water is taken from the top of these tanks, where it is cleaner.

5. Chlorination — As with groundwater, small amounts of chlorine are added to kill any bacteria which may still be in the water.

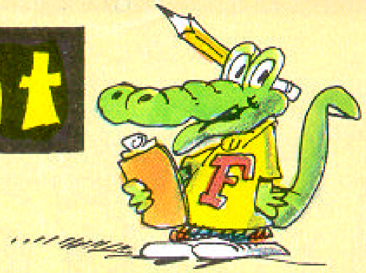
Spray it, drain it and strain it — that's what they do to make surface water ready to drink. Then they pump it into large underground pipes called mains and send it on its way to where it's needed. Just turn on your faucet, and, presto-gusho, out comes the water, clean and drinkable.


Water.. Water..
Did you know the Eskimos have something like 26 different words for snow? No big deal…In South Florida we've got about the same number of words for water.
Think about it. We've got rainwater, groundwater, flood water, irrigation water, water vapor, raw water, drinking water, wastewater…and more, right? That's because we use water in so many different ways. Let's check it out.
F
2 Irrigation Water. A lot of our water goes for irrigating citrus groves, vegetables, sugarcane and other agricultural uses. Often irrigation water is diverted directly from lakes or canals, but quite a bit comes from wells, too.
CANAL
CAFE
AQUIFER



Water..
1 **Surface Water.** The first stop for rain water is on the earth, where it's known as surface water. Besides taking care of all of us creatures of nature, this is the water that flows into—and is stored in—lakes, rivers, conservation areas and canals.
3 **Sewage Treatment.** Used water—wastewater or sewage—is collected and piped to treatment plants for processing. Most of the impurities are removed here.
SEWAGE TREATMENT
5 **Recreation.** I've never heard of a name for water used in recreation, but whatever you call it, we use a lot of it here for everything from fishing to swimming to sailing and so on.
COUNTY PARK
4 **Reclaimed Water.** This is wastewater which has been treated and released for use again, mainly for non-crop irrigation such as on parks or golf courses.
6 **Groundwater.** Most of the water used in South Florida cities comes out of the ground. People use it in their homes and for heavy duty things like in hospitals and for fire fighting. A lot of businesses need water, too—not just office buildings, but things like manufacturing and food processing.

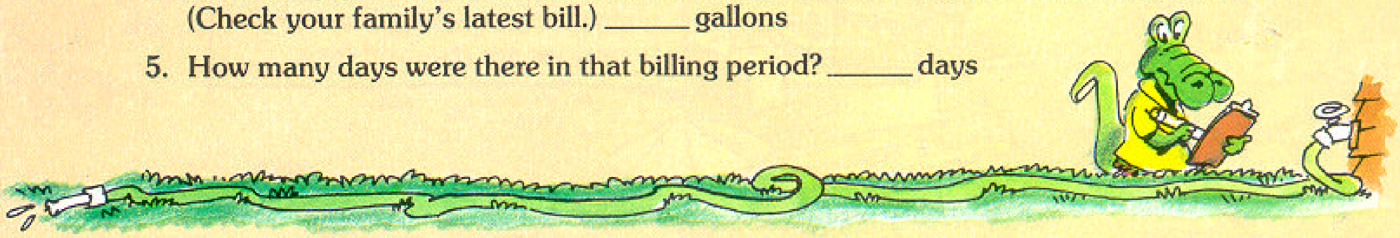
Home Water Audit



Here's a chance for you to find out some more information about your family's water use. You'll probably need to talk to the other members of your family in order to complete all of the items accurately.

GENERAL INFORMATION

1. What type of home do you live in? (check one)
   ____ house ____ apartment/condominium ____ mobile home
2. How many people are living at home? ______
3. What are the ages of the children living at home?
   ____ ____ ____ ____ ____ ____
4. How many gallons of water were used in your home during the last billing period? (Check your family's latest bill.) ______ gallons
5. How many days were there in that billing period? ______ days



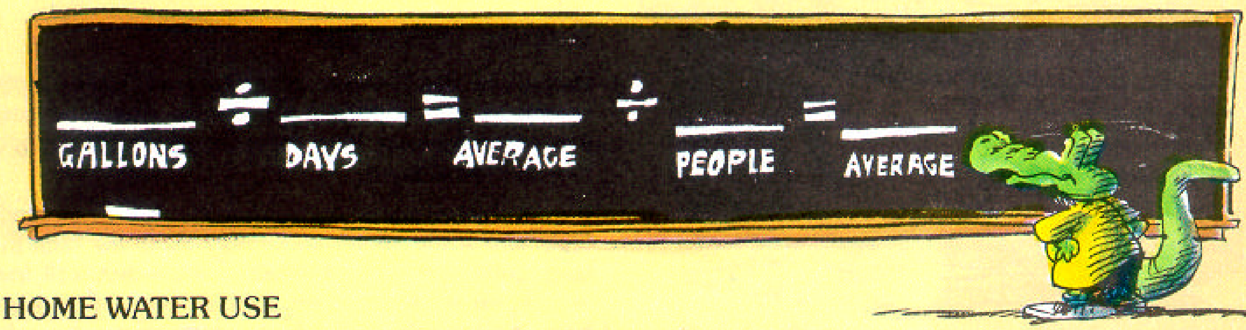
SPECIFIC WATER USE—Outside the home

1. What size is your lot compared with other lots on your street? (check one)
   ____ larger ____ the same ____ smaller
2. What type of plants do you have? (check all that apply)
   ____ lawn or ground cover ____ flowers and/or shrubbery
   ____ vegetable garden and/or fruit trees
3. Outside watering for the months October to June. (estimate)
   ____ number of watering minutes per day (total number of minutes each hose or sprinkler is run every watering day).
   ____ number of watering days per week.

SPECIFIC WATER USE—Inside the home

1. Dishwasher (answer only if you have one)
   a. How many times per week is the dishwasher run? ______
   b. How full is the dishwasher usually loaded?
   ____ full ____ half full ____ less than half full

2. Washing machine (answer only if you have one)
   a. How many loads per week are usually washed?____
   b. How full is the washing machine usually loaded?
   ____ full ____ half full ____ less than half full
3. How many of each of the following do you have in your home?
   ____ sinks ____ showers ____ bathtubs ____ toilets
4. How many showers per week are taken in your home?______
5. How many tub baths per week are taken in your home? ______
6. How many minutes is your family's average shower? ______ minutes
7. How many times each day is a toilet flushed in your home? ______ times
8. Is there any other place where a significant amount of water is used in and/or around your home? (Examples: automatic sprinklers, hot tub, swimming pool, etc.)



HOME WATER USE

1. Figure out how much water is used per person (per capita) in your home every day by using the following formula:

______	÷	______	=	______	÷	______	=	______
gallons per billing period		number of days in billing period		average daily consumption		number of people in home		AVERAGE USE PER PERSON

2. Figure out how much water is used outside your home by using the following formula:

______	×	______	=	______	÷ 60 =	______
watering minutes per day		watering days per week		watering minutes per week		watering hours per week

______	×	______	=	______
watering hours per week		1800 gallons per hour		GALLONS PER WEEK OUTSIDE WATERING

3. Figure out how much water is used inside your home by completing the chart below.

WATER USE ACTIVITY	USES/WEEK	GALLONS/USE	TOTAL WATER USE/WEEK
DISHWASHER	______	15	______
WASHING MACHINE	______	60	______
SHOWERS	______	30	______
TUB BATHS	______	35	______
TOILET FLUSHES	______	6	______
TOTAL WATER USE/WEEK			______

Cleaning up the Wastewater

This is called wastewater, and it can contain leftover food, chemicals, human waste, detergents and other stuff that can be harmful to other people and us creatures in the environment.

Lucky for us, when you send it down the drain and forget about it, other people don't. That's because before wastewater goes back into the world of water, it gets treated. Then, once the wastewater is treated, we can safely dispose of it or reuse it.

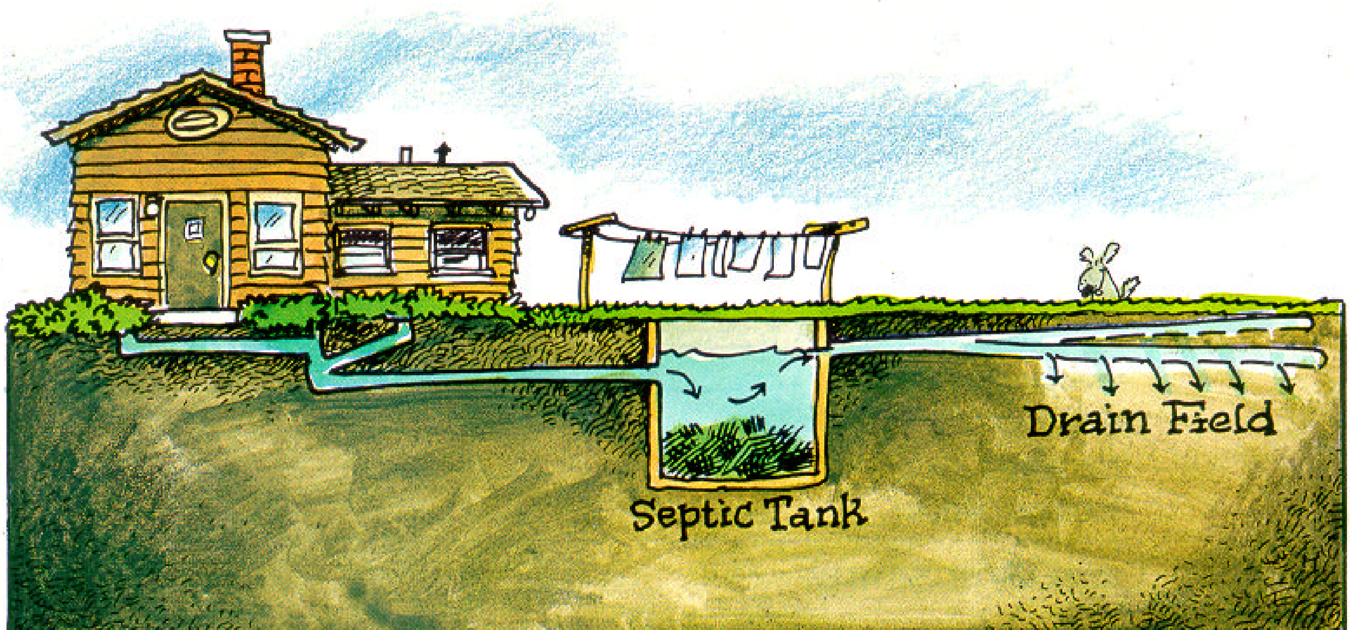
The two main ways that wastewater gets cleaned up are by individual units called septic systems, and by big cleanup facilities called wastewater treatment plants.

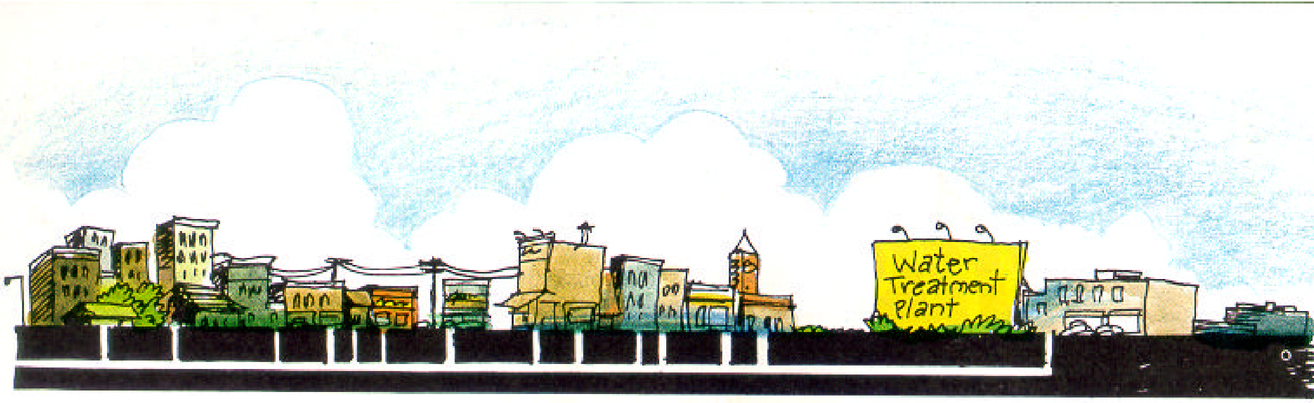
Septic Systems:

People who don't live near a big city usually have a septic system to treat their own wastewater. That's because they're too far away from the sewer pipes that connect to a treatment plant.

A septic system has an underground tank, called a septic tank, where the wastewater goes first. In the tank the large solids collect and break down — they call that decomposing. Decomposing happens because there are harmless bacteria in the tank which cause the solid material to turn into water and vapor.

The vapor slowly escapes, and the wastewater flows out of the septic tank through pipes into a septic drainfield. In the drainfield, chemicals destroy bacteria, and fine particles are trapped in the soil. The purified water then filters down into the earth below.





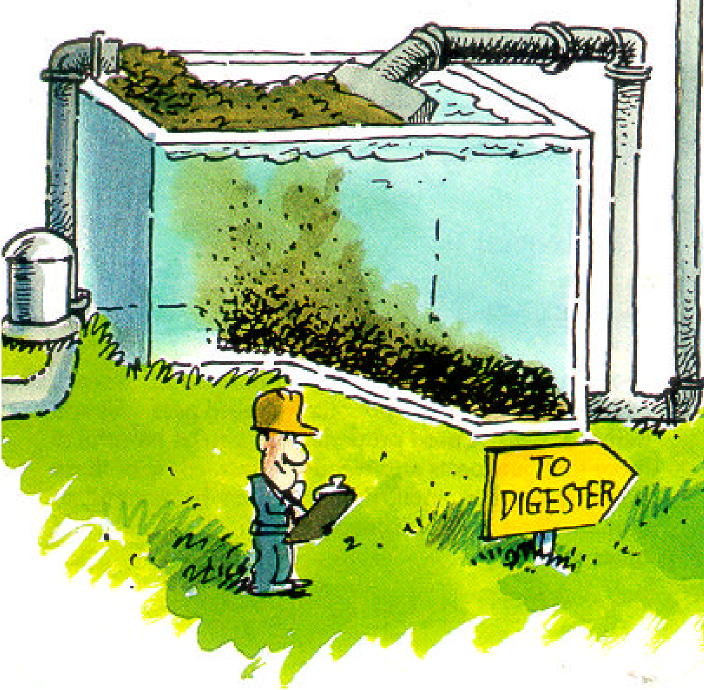
Wastewater Treatment Plants:

In areas with lots of people, there are wastewater treatment plants that do the job of septic systems, but on a much bigger scale. Many people live in areas where their drains connect to sewer pipes, and these pipes carry wastewater from thousands of homes and businesses to treatment plants.

In a treatment plant the wastewater gets cleaned up in several steps, but the steps are in two main groups that are similar to the two stages of a septic system.

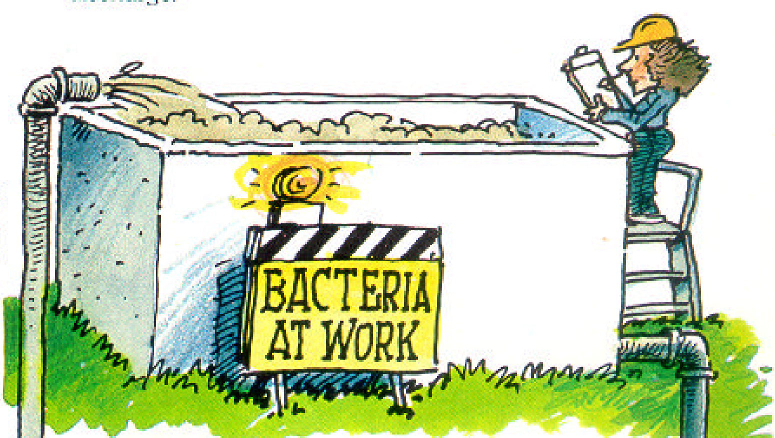
Primary Treatment

The first level is called primary treatment. The goal of primary treatment is to remove solids that either settle to the bottom or float to the top of wastewater. They have things like bar screens, grit chambers and sludge ponds where they take out the materials that are easiest to remove. The wastes go to digesters, which are like septic tanks because bacteria help to decompose the wastes.

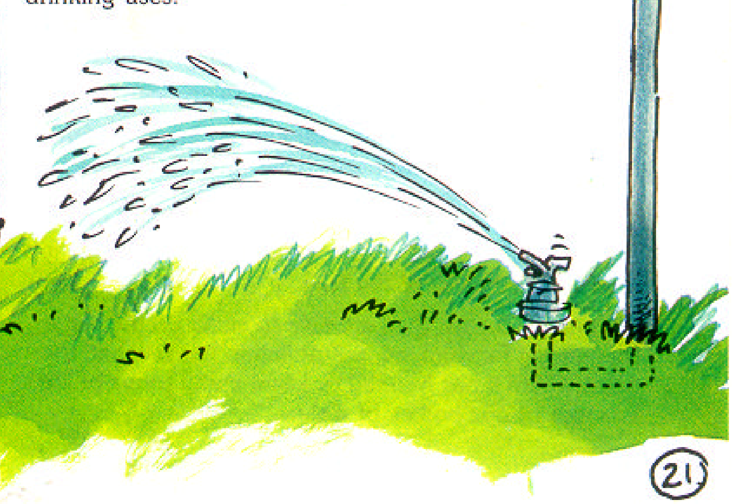


Secondary Treatment

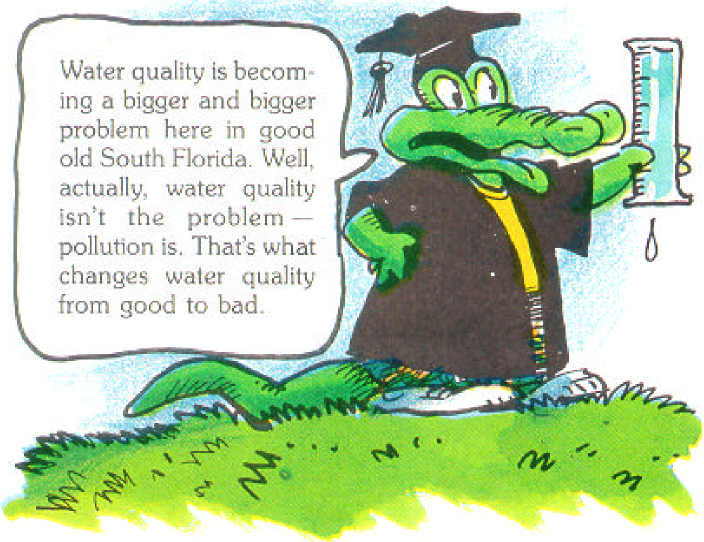
The next stage in a treatment plant is called secondary treatment. This process cleans the water even more by using other bacteria which can "digest" smaller impurities suspended in the wastewater. As a result, the treated water coming out of a wastewater treatment plant is much cleaner that when it came in, and is safe to discharge.



Called effluent, this water goes into a river or bay. Or, it might go into a well where it can percolate into the ground. Other times, after more treatment, effluent is reused for irrigating crops, cooling equipment or watering lawns and gardens. They call this reclaimed water, and more and more of it is being used these days for non-drinking uses.



Pollution and Solutions



When you pollute something, you put something in it to make it unclean. Water gets polluted when things get in it that make it unhealthy for people or the environment.

For example, nitrogen and phosphorus make plants grow faster. But, if you get a lot of these chemicals in the water, you can encourage the growth of certain unwanted plants in the water. When this happens, the unwanted plants can use up all the oxygen in the water. Then, other plants and animals die due to lack of oxygen.

Take Lake Okeechobee, for example. So many nutrients like nitrogen and phosphorus have gotten into the lake that plant and animal life has been threatened. In some years large areas of the lake have been choked with a plant life called algae, which cuts off oxygen and greatly reduces the health of the lake.

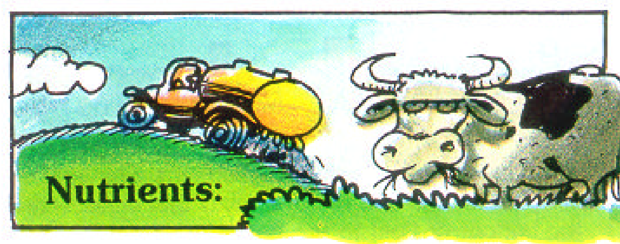
Fortunately for us, they are able to clean up the water that we get for drinking, but pollution has reached the point where it has harmed or killed many forms of life in some of our bodies of water.

And, as our population continues to grow, pollution could reach the point where it becomes a problem for our drinking water, too. For example, in some parts of the country, people have dumped chemicals on the ground that have soaked down into the aquifers, making it dangerous to use the groundwater in that area.

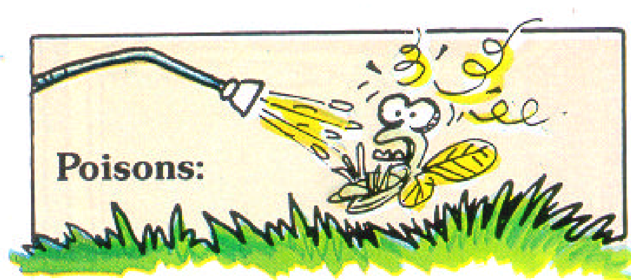
One major problem has been from old gas stations. They store their gasoline in underground tanks, and some of the old-style tanks have leaked thousands of gallons of gasoline into the groundwater — almost like an underground oil spill. Sometimes this can be cleaned up, but the process takes a long time and is very expensive.

The main way that pollution gets into lakes, streams and wetlands is stormwater runoff. This is the rainwater that drains off the land. It picks up pollution from farms, yards, streets and parking lots. It gets into the surface waters wherever it drains, carrying the impurities with it.

Let's take a look at some of the things that pollute our water, and why they're such a problem.

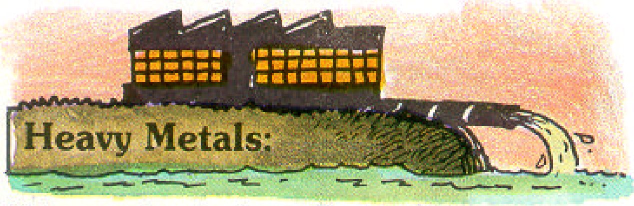


The nitrogen and phosphorus I was talking about are examples of nutrients — things that make other things grow. They can come from fertilizer. Phosphorus also can come from animal manure on farms. When heavy concentrations of nutrients get into the water, they can cause the algal blooms I mentioned. This not only uses up oxygen, it also blocks sunlight. And when the algae dies it decays in the water, giving it a bad taste.

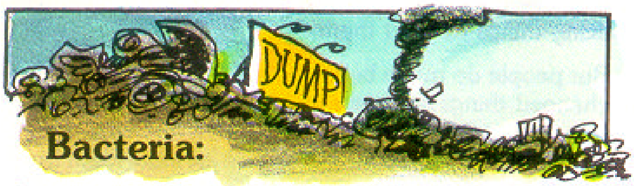


People use sprays and other chemicals to kill insects, pests and weeds. These poisons are called pesticides and herbicides. If not used properly, they can be harmful to more than just pests and weeds. In fact, some of these poisons, even in small amounts, can be harmful to humans. And many are deadly for fish, plants, birds and other wildlife.

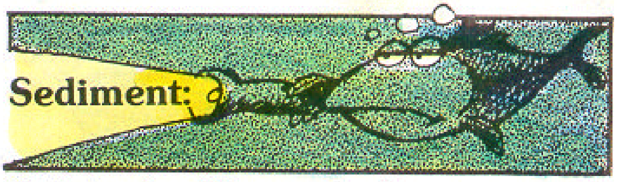
These are similar to poisons, in that they can kill. But they weren't meant to get into the systems of plants and animals. They are things used for other purposes, but then got dumped where they got into the water. Oils, paints, gasoline, cleaning solvents, waxes and antifreeze are just a few. Just like some pesticides, they can kill plant and animal life in water.



We're not talking loud music here! Metals may be found suspended in water in very, very tiny particles which are so small they are not visible. Fish and other wildlife, and humans, too, may be extremely sensitive to these metals. Lead from old car batteries is a problem. So are other heavy metals like copper, zinc, mercury, cadmium and chromium.



Sometimes when people are sick they say they've caught a "bug." What they've really got is a bacteria or virus — also known as germs. Bacteria can get into the water supply from many sources, including garbage, animal manure and leaking septic tanks.



Dirt that washes off the ground and into stormwater will settle out some place else, as soon as the water slows down and it gets a chance to sink. When it settles to the bottom it is called sediment. The dirt makes the water cloudy and fills up stream beds and lake bottoms. It keeps plants from growing, covers up shellfish beds and carries other pollutants from the soil with it.

The more people you have, the more pollution you're likely to have. I guess you can see that as South Florida keeps growing, so do its pollution problems. A lot of programs have been started to cut down on pollution, but every person can stop being a part of the problem and start being a part of the solution.

How You Can Help

Here are a few ways you and your family can help.

- Only use pesticides when you need them. There are more natural ways to kill unwanted pests. Contact your county extension agent for details.
- Don't use too much fertilizer, and don't fertilize near surface water areas. Follow instructions and there won't be as much chance of the chemicals ending up in our water.
- Get rid of hazardous wastes properly. Take them to collection sites instead of dumping them out on the ground or in your household garbage.
- Never water paved areas. Besides being wasteful, the water carries away oil and grease that is bad for the environment.

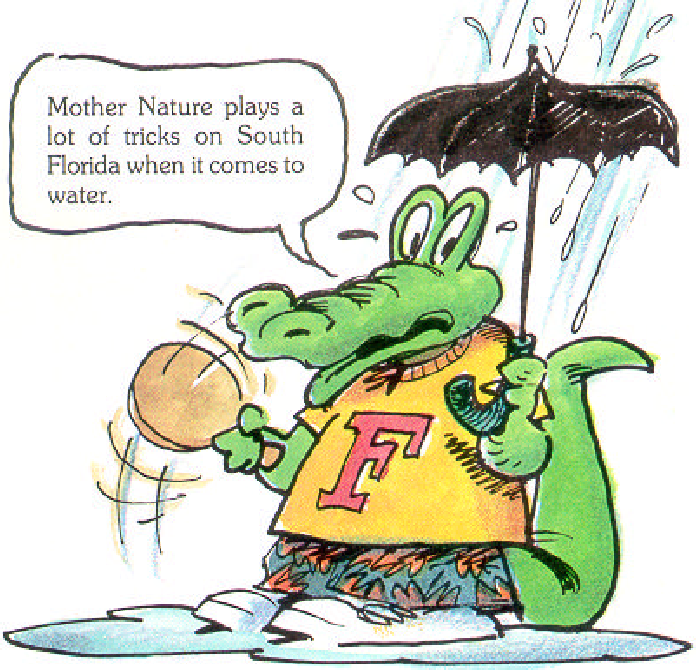
Xeriscape

One way to save a lot of water at home is with a new kind of landscaping, called Xeriscape. The basic idea is to use as many plants as possible that don't need watering. And plants that do need watering, like certain flowers, bushes and lawns, are grouped together.

Here are the basic steps to Xeriscape:

- **Design** yards that take advantage of things like where there is already shade and where water drains.
- **Choose** mostly plants that can live on normal rainfall, and put plants with similar water needs into three groups — those that need no watering, those that only need watering during dry spells and those that need regular watering.
- **Improve the soil** by adding compost or other organic material that holds water longer than our natural sandy soil.
- **Use grass wisely** — mainly where people play or relax. Other areas can be planted with low-growing, low-water-use plants called ground cover.
- **Water wisely** — only when plants need it, and with equipment that prevents water waste from wind, evaporation or gutter flooding.
- **Use mulch**, like oak leaves or shredded bark, to cover dirt under plants — it reduces evaporation and keeps out weeds.
- **Take it easy** — a Xeriscape yard doesn't like too much water or too much fertilizer, and the grass likes to be tall.

Water Supply Problems



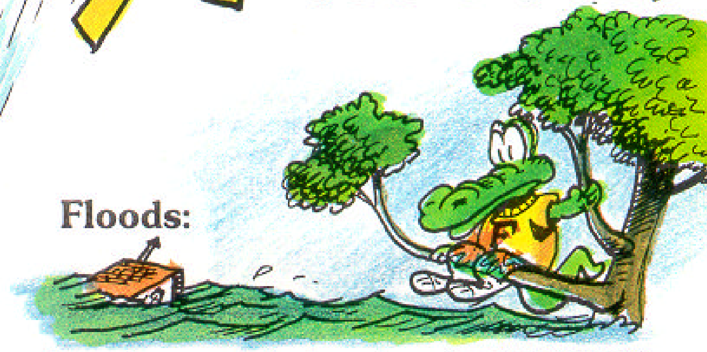
We get an average of 55 to 60 inches of rain a year. The rain, coupled with our warm temperatures, is the kind of weather we call subtropical (wet and warm).

If you could save all the rain we get, you could cover the entire area with almost five feet of water in a year. Lucky for us, water sinks into the ground and runs off into streams, canals, lakes and bays. So we aren't flooded out by all that rain — most of the time.

But our weather seems to have an all-or-nothing attitude. Sometimes it seems to pour down day after day, at other times — for weeks — it's as dry as a soda bottle after a slumber party. They call this seasonal variability — wet summers that bring about two-thirds of our rain, and dry winters when everybody wants the water from the rain we're not getting.

Because of these weather extremes, we also wind up with floods when we get too much rain at once, and droughts when we don't get enough. First, let's talk about too much.

Floods:



To get the amount of rain we do, we have to put up with some pretty big storms. We get so much rain that we have some pretty bad floods. In fact, parts of South Florida were flooded as recently as 1982 and 1988. Homes and businesses were flooded with as much as a foot of water or more. In a few days we can get as much rain as we would expect over two or three months.

Way back before people were here, flooding was an important part of the natural life cycle in the area. When there were floods, nutrients were carried to places where living things needed them.

But people do much better without floods. And, we've changed things so much with draining wetlands, with new buildings and with paved areas, that the whole picture is different. Today floods do a lot more harm from pollution and damage than they used to.

The South Florida Water Management District has done a lot of work to control floods, like building canals and putting in other controls to keep flooding down to a minimum. Still, with super-heavy rains, flooding remains a threat.

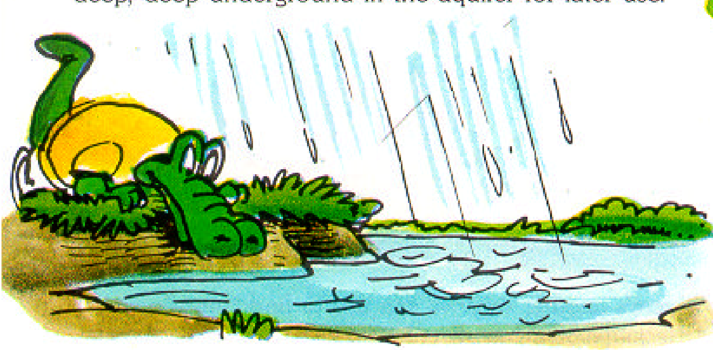
Droughts:

The other extreme of our weather is droughts. These are long periods of time when we don't get any rain. During times of drought our water can be in very short supply. In fact we've had water shortages as recently as 1981, 1985, 1989 and 1990. It's interesting that sometimes we have wet and dry years back-to-back — like in 1981-82. It just shows you how changeable Florida's weather is.

Surface Water Development

It might be possible to use more of the surface water that we get from rain. But to do this we have to keep it from getting polluted and figure out how to store it in the rainy season so we'll have it during the dry part of the year.

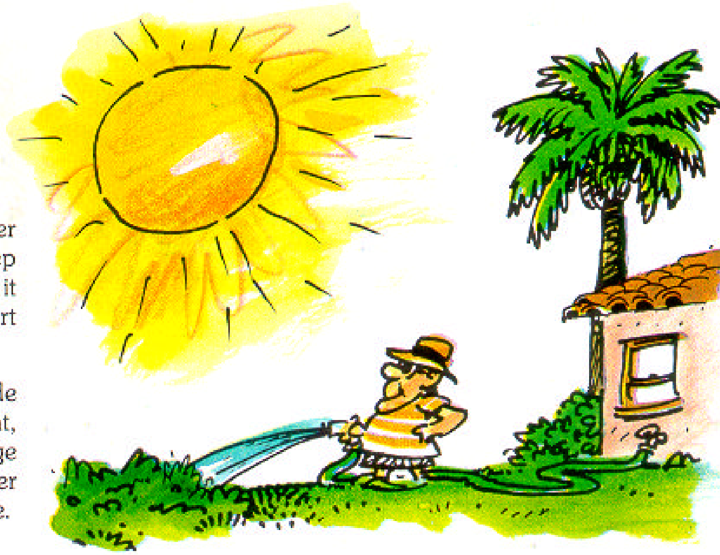
Usually, surface water is stored in lakes or man-made reservoirs. In reality, because South Florida is so flat, there aren't many good places to build water storage areas. There is, however, a new way of storing water deep, deep underground in the aquifer for later use.



And, engineers keep looking, trying to find ways to collect more surface water that will help us meet the growing demands for water.

Conservation

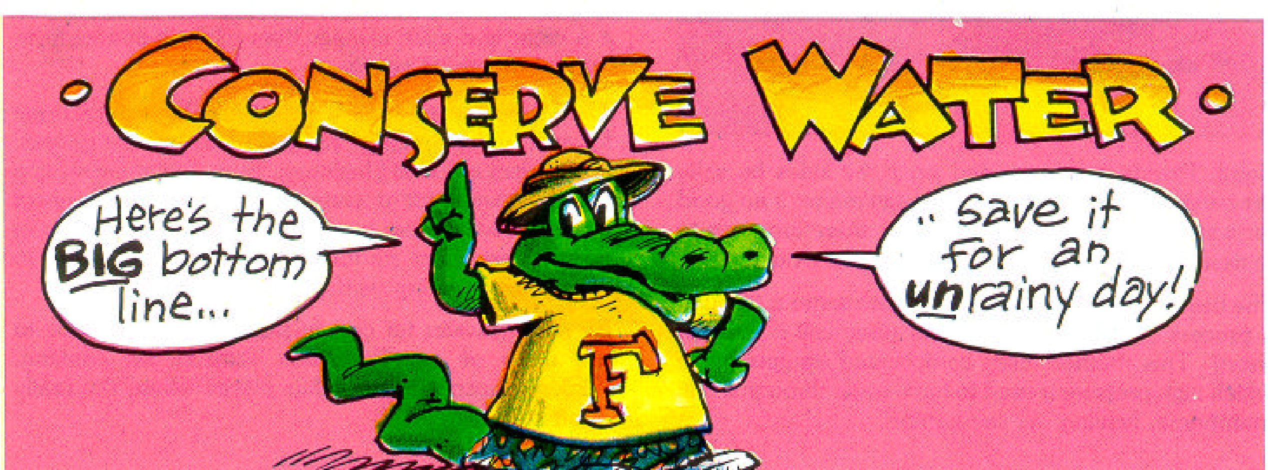
The one thing that everybody can do to help us get the most out of our supplies is to conserve water. In case I haven't mentioned it, conservation means preventing loss from waste — you know, wise use. Conservation doesn't provide us with more water — it just means we can use less water to do the same jobs.



So, when we conserve water, we save it for an unrainy day. When we use less, we leave more, which means we'll have more available the next time there's a water shortage.

Water conservation is kind of like saving money — if you don't spend it now, you'll have it when you need it, like for an emergency.

On the following pages we're going to have some fun talking about conservation and how you can save. But, remember, water conservation is no joke. In fact, it's the best way I know for people to help each other and the environment, which means plants, and wildlife like you-know-who (ME!), and humans, too!



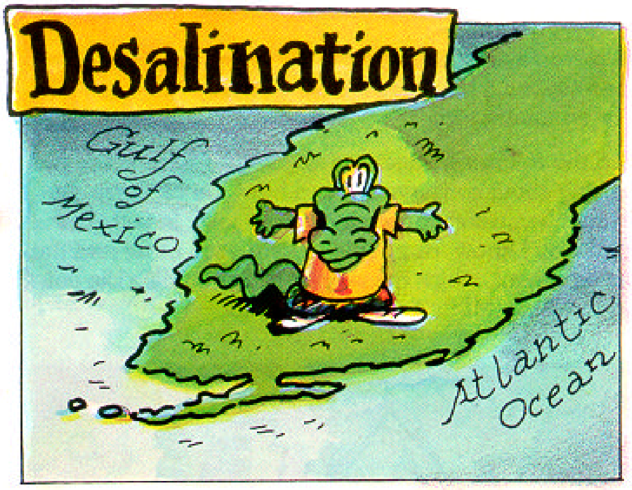
Finding More Water

You've already seen how scarce water can get here in South Florida. Here's something else to think about. We'll never have any more rain than what we've been getting over the years — an average of about 55 to 60 inches per year.

But, even though we can't make more rain, we can count on having more people. South Florida is growing at the rate of a million people about every 10 years. That's a lot of people who have to get by on the same amount of water. So we have to do all we can to stretch our supplies.

Here are a few things being done to make our water go farther.

Desalination

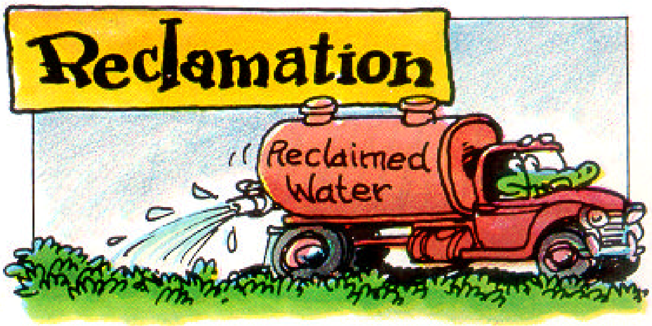


South Florida is surrounded on three sides by salty seawater. This stuff is wet, but the salt makes it no good for watering plants or drinking. But, there are ways to to desalinate seawater, which means to take out the salt.

The best way we know of to desalinate water is through a process called reverse osmosis (they call it R.O. for short). This method uses complicated equipment in which high pressure is used to force water through a thin membrane, leaving the salt behind.

Because it takes a lot of electrical power to make reverse osmosis work, it is a very expensive way to produce drinkable water. If you're using R.O. for your water supply, you're going to pay a lot more per gallon than you would if you could get well water. But R.O. works, and if it's the only way to get the water you need, it's better than going dry.

Reclamation



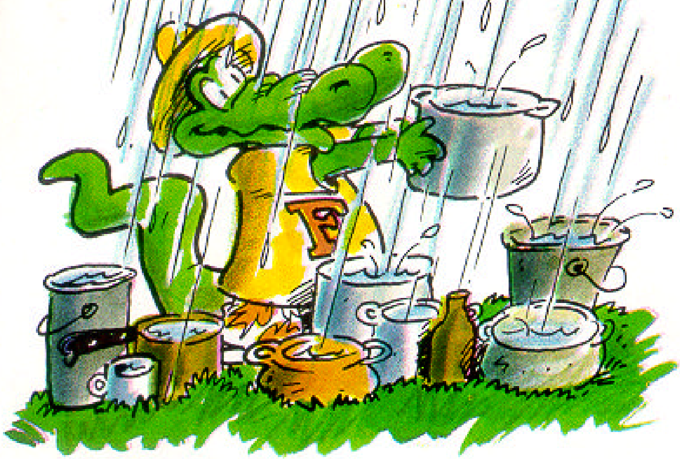
Here's another way we can use to find "more" water. Reclamation means cleaning up water that we've already used, then using it again. Another word for reclamation is reuse.

Reuse is found in cities with wastewater treatment plants, because the wastewater is what we reuse. What they do is to treat the wastewater to a very high level, so that it is clear and even cleaner than when it comes from normal treatment plants.

This highly treated water is being reused more and more for such things as watering grass and plants in parks, golf courses and along highways. Some farms are reusing their own water for growing crops, and certain kinds of factories reuse water in manufacturing. Some cities in South Florida are starting to supply reused water to homes for watering yards.

By reusing water for certain purposes, we are able to use more of our freshwater supplies for cooking, drinking, hospitals and other places where the really clean stuff is needed.

Surface Water Development



Part of why we're not able to hang on to all of that rain is that it disappears into thin air. Experts say that we lose as much as 45 inches of our rain back into the atmosphere. This happens by evaporation, and by evapotranspiration — plants releasing water vapor into the air. Furthermore, coastal rainfall drains immediately into the sea because there's no place to store it.

One place where you notice the drought is in our lakes, like Lake Okeechobee. It is a major part of South Florida's water supply network. In drought times, the level of the lake can drop several feet.

But our water shortage is not just in the lakes. As we talked about earlier, South Florida gets most of its water from underground. You probably remember that the water we take out of the aquifers is replaced with rain water soaking down. But during a drought, less rainfall means less water reaching the aquifers.

Since some of our main aquifers are located along the coast, when the water we pump out is not replaced by rainwater, then saltwater can seep in from the ocean. This is called saltwater intrusion. Over the years aquifers on both coasts of South Florida have had major problems with saltwater intrusion.

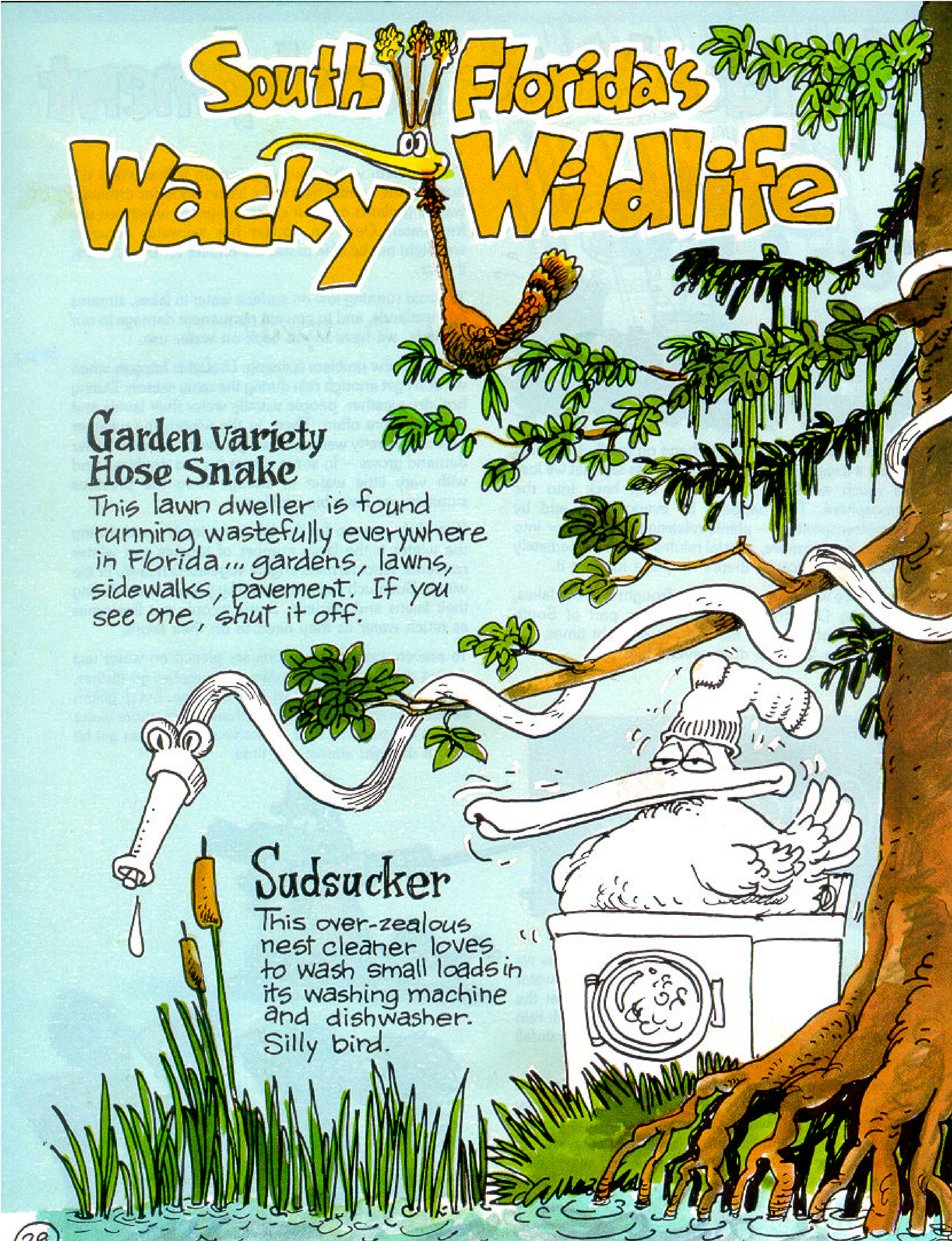
The problem with saltwater intrusion is that when the water in the aquifer gets salty, it's no good for drinking, watering plants or most other things for which we use freshwater. Once an aquifer has saltwater intrusion we might not be able to use the aquifer for many years, if ever.

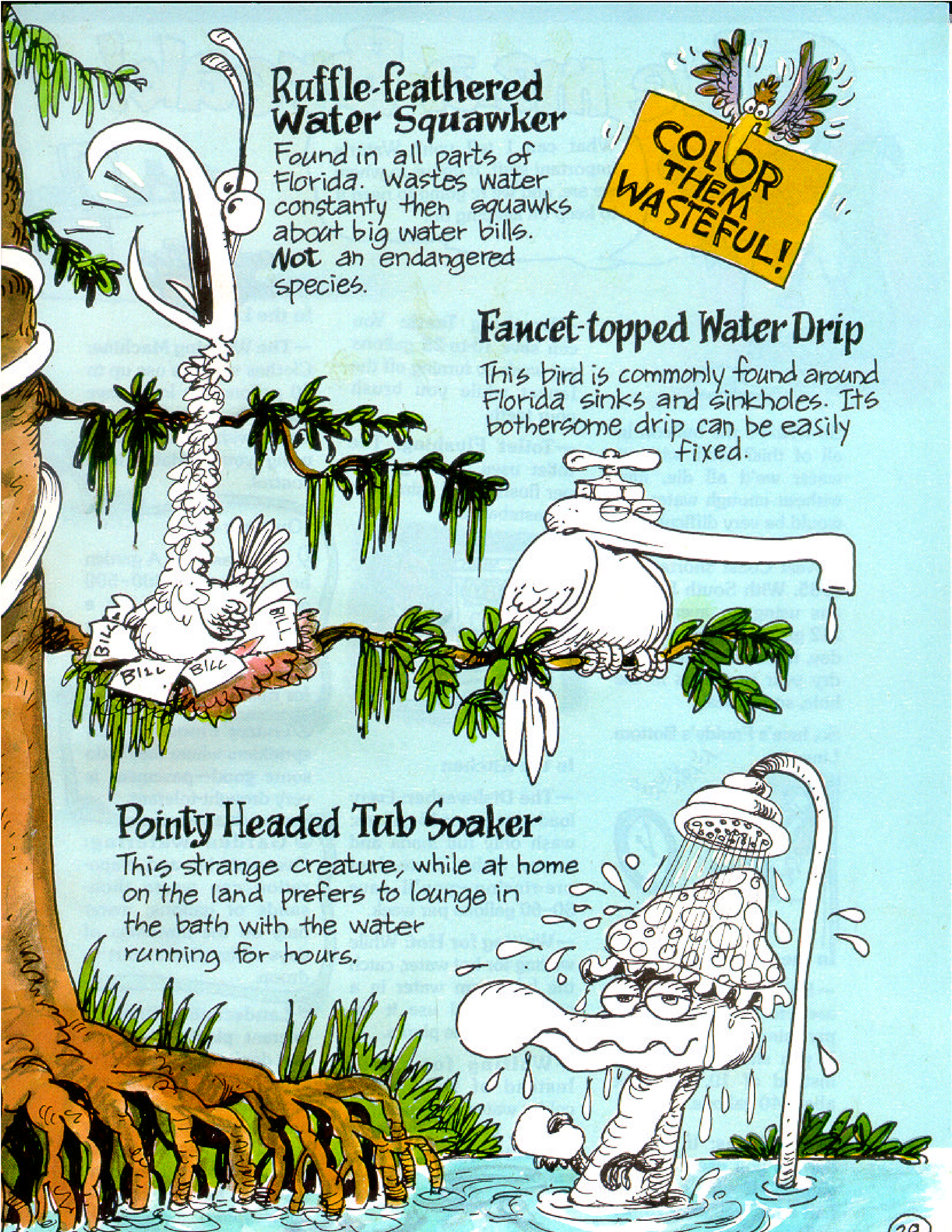
To avoid running low on surface water in lakes, streams and wetlands, and to prevent permanent damage to our aquifers, we have to cut back on water use.

Adding to the problem is timing. Droughts happen when we don't get enough rain during the rainy season. During hot, dry weather, people usually water their lawns and gardens more often. Then, in the winter, the weather here is still pretty warm and we get almost no rain. Water demand grows — in some places it even doubles. And with very little water in storage from the previous summer, we have big problems.

Part of the reason for the big jump in demand during the winter is the large number of tourists and winter residents. Also, farmers irrigate vegetables heavily in the winter. But much water is wasted by people overwatering their lawns and gardens. Some people put five times as much water as they need to on their lawns.

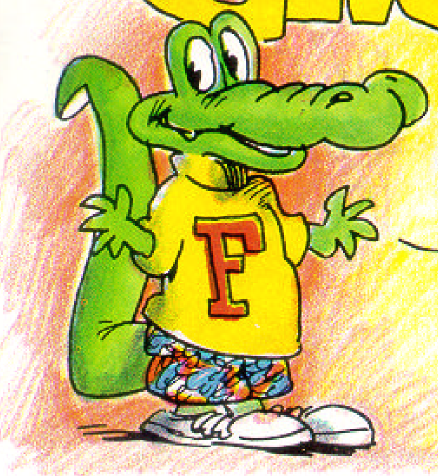
To prevent waste, restrictions are placed on water use during droughts. But to make our supplies go farther, people need to be water wise all the time. Every gallon saved in times of plenty means there will be more water for the dry periods. And, as we've seen, we can get hit with a drought almost any time.


South Florida's
Wacky Wildlife
Garden variety Hose Snake
This lawn dweller is found running wastefully everywhere in Florida... gardens, lawns, sidewalks, pavement. If you see one, shut it off.
Sudsucker
This over-zealous nest cleaner loves to wash small loads in its washing machine and dishwasher. Silly bird.



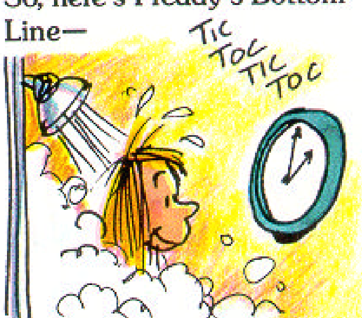
Ruffle-feathered Water Squawker
Found in all parts of Florida. Wastes water constanty then squawks about big water bills. Not an endangered species.
COLOR THEM WASTEFUL!
Faucet-topped Water Drip
This bird is commonly found around Florida sinks and sinkholes. Its bothersome drip can be easily fixed.
BILL
BILL
BILL
BILL
Pointy Headed Tub Soaker
This strange creature, while at home on the land prefers to lounge in the bath with the water running for hours.

Give me a Break!



So where's the bulletin in all of this? Well, without water we'd all die, and without enough water life would be very difficult. We had a drought in 1981, and a West Coast shortage in 1985. With South Floridians using an average of 212 gallons per person per day, it doesn't take a very dry year to put us in the hole, so to speak.

So, here's Freddy's Bottom Line—



In the Bathroom

—Shorter Showers: You use 5-to-7 gallons of water per minute in the shower. If you shower 3 minutes instead of 10, you save about 40 gallons.

—Tub Baths: If you fill the tub you use about 35 gallons. If you only use half a tub, you save 15–20 gallons.

—Brushing Teeth: You can save 10-to-25 gallons per week by turning off the faucet while you brush your teeth.

—Toilet Flushing: The toilet uses 5-to-7 gallons per flush; avoid using it as a wastebasket.

In the Kitchen

—The Dishwasher: Every load uses about 15 gallons; wash only full loads and scrape dishes instead of pre-rinsing—you'll save 30–60 gallons per week.

—Waiting for Hot: While waiting for hot water, catch the lukewarm water in a container and use it for watering house plants.

—Waiting for Cold: Instead of waiting for colder water to come from the tap, keep a pitcher of ice water in the refrigerator.

In the Laundry

—The Washing Machine: Clothes washers use up to 60 gallons per load; save hundreds of gallons per month with full loads or by using your variable load control.

Outdoor Use

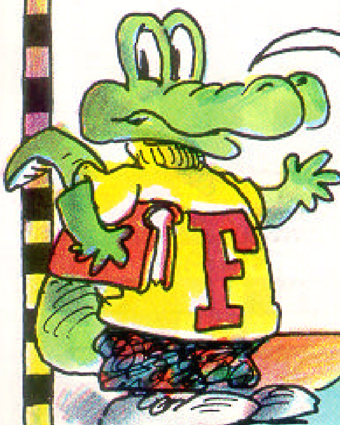
① **Car Washing:** A garden hose puts out 300–500 gallons per hour; use a bucket for soapy water and a hose with an automatic shutoff nozzle for rinsing.

② **Gutter Flooding:** Aim sprinklers where they'll do some good—pavement is very drought-tolerant.

③ **Garden Watering:** Over-watering and evaporation can waste thousands of gallons; water only on the mornings of days when plants start to droop.

④ **Landscaping:** Drought-tolerant plants—the kind that don't need watering—come in many varieties, are beautiful, and don't require precious water during dry spells. The key word here is Xeriscape—water conservation through creative landscaping.

Water Trivia



How's your knowledge of aquatic obscurities? See how you do with these questions about water.

1. Name a professional team sport played in the U.S. that requires water.

2. How much does all the water weigh that evaporates from the earth in a single day?

3. What percent of all living matter is water?

4. How many glasses of water does it take to grow the oranges for one glass of orange juice?

5. Why does water put out fires?

6. What is the longest anybody has stayed underwater without being in a vessel?

7. What is the average rainfall per year in South Florida?

8. Who is Protector of the Everglades?

9. What percent does water expand when it freezes?

10. How many times more space does water take up when it evaporates than when it is liquid?

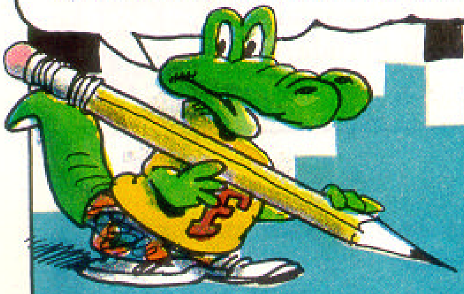
11. What is the fastest speed reached by a falling raindrop?

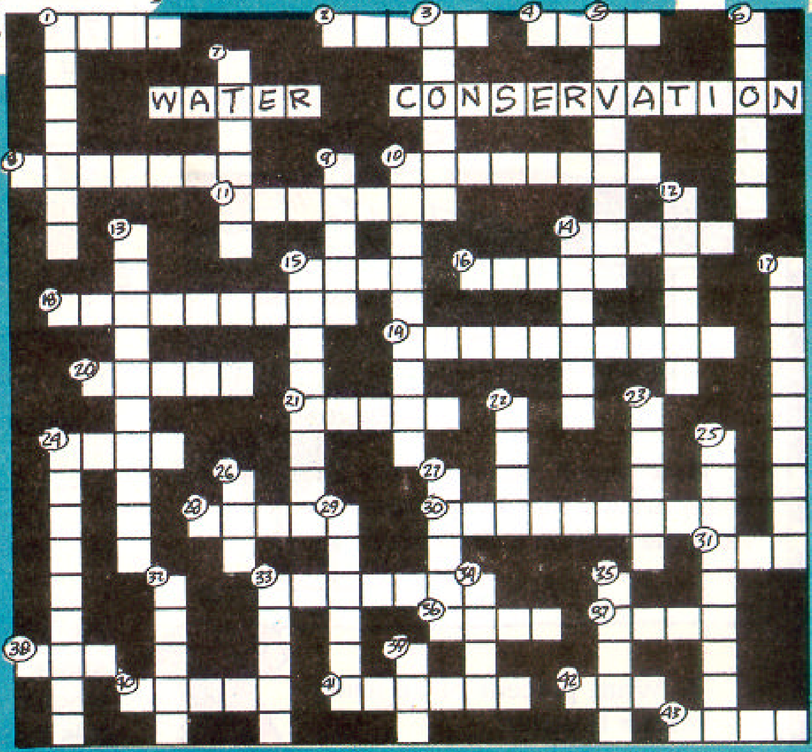
12. How much of the earth's rain falls directly back into the ocean?

Answers: 1. ice hockey; 2. 16 million tons; 3. 80%; 4. 50; 5. it cools them to below burning temperature; 6. 126 hours, 30 minutes; 7. 55-60 inches; 8. SFWMD's Freddy the Alligator; 9. 9%; 10. 1642; 11. about 7 mph; 12. about 91%.

Water Crossword

This puzzle features 49 water words used in this unit. See how well you've learned the vocabulary by studying the clues and writing the correct words in the spaces provided. If you have a problem, check your glossary.





ACROSS
1. Precipitation in the form of crystals of frozen water
2. Non-forested wetland dominated by aquatic plants
4. Shallow container, equipped with faucet and drain, used for washing
8. Large aquatic mammal of warm Atlantic coastal waters; an endangered species
10. Process of replacing groundwater
11. Large underground bed of sand and gravel which holds water
14. State of water after boiling
15. Hole drilled in the ground to reach a water supply
16. Embankment raised to prevent flooding
18. Artificial lake used for water storage and recreation
19. Process of supplying water to dry land by artificial means
20. Land saturated with water dominated by trees
21. Metric liquid measure
24. Flexible tube used to deliver water
28. Device used to measure water consumption; water ________
30. Large amphibious reptile; Freddy
31. Solid form of water
33. Reducing the potential for flood damage by channelizing streams and building water control structures; flood ________
36. Liquid precipitation
37. Section of a waterway closed off with gates, used to raise or lower the water level to allow boat passage
38. Body of water partly enclosed by land but having a wide outlet to the sea
40. Constructed channel filled with water
41. Device which delivers water from a pipe
42. Small bowl used to hold liquids
43. Slow discharge of water

DOWN
1. Water stored on top of the land; lakes and rivers; ________ water
3. Device used for bathing which delivers water in a spray, fine stream or drops
5. To travel by water
6. Swamp, especially one that is an inlet or backwater
7. Small flowing body of water
9. Flowing body of water of considerable volume
10. Water purified to a level acceptable for some non-potable uses; ________ water
12. Four quarts; a liquid measure
13. Appliance used to clean dishes
14. Human wastes carried off by sewers
15. Animals living in a natural setting
17. Water conservation through creative landscaping
22. Water container used for swimming
23. Water which has been used; ________ water
24. Severe tropical storm with high winds and heavy rains
25. Device used to water a lawn
26. Condition of not being dry
27. Water in the form of a gas
29. Rain in excess of the amount absorbed by the ground
32. Huge body of salt water which covers ¾ of the earth
33. Route water takes as it changes forms between earth and sky; water ________
34. Natural, non-flowing body of water
35. Visible mass of tiny water droplets, mixed with vapor, suspended in air
39. Container in which one bathes